A DISSERTATION ON

A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE- LIGNOCAINE AND BUPIVACAINE- LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY

COIMBATORE MEDICAL COLLEGE HOSPITAL

Dissertation submitted in

Partial fulfilment of the regulations required for the award of

M.D. ANAESTHESIOLOGY

BRANCH-X

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

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DECLARATION

I, **Dr. SANTHANABABU V** solemnly declare that the dissertation entitled **"A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE - LIGNOCAINE AND BUPIVACAINE - LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY"** was done by me at Coimbatore Medical College, during the period from **July 2015 to July 2016** under the guidance and supervision of **Dr. K. SANTHA ARULMOZHI M.D.,DA.,** Professor and HOD, and **Dr. RADHA M.D.,** Assistant professor, Department of Anaesthesiology, Coimbatore Medical College, Coimbatore.

This dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University towards the partial fulfillment of the requirement for the award of M.D. Degree (Branch - X) in Anaesthesiology. I have not submitted this dissertation on any previous occasion to any University for the award of any degree.

Place:

Date:

Dr.SANTHANABABU .V

CERTIFICATE

This is to certify that the dissertation entitled, "**A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE- LIGNOCAINE AND BUPIVACAINE - LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY"**, is a bonafide research work done by **DR.SANTHANABABU V,** under my guidance during the academic year 2014 – 2017.

This has been submitted in partial fulfilment for the award of **M.D. Degree in Anaesthesiology (Branch – X)** by **The Tamilnadu Dr. M.G.R Medical University, Chennai – 600 032.**

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BRANCH-XI

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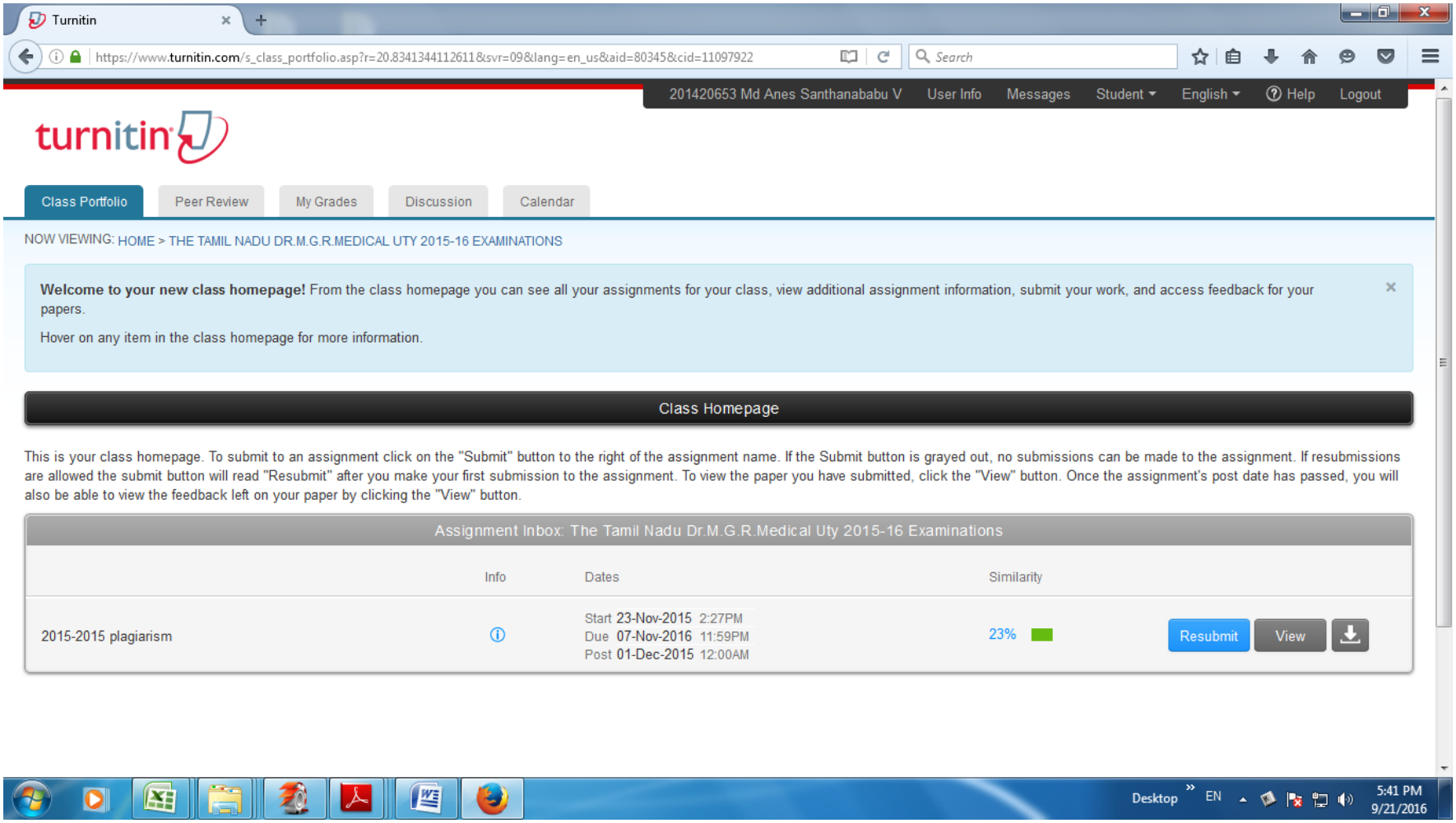
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INTRODUCTION

Supraclavicular brachial plexus block is many times called as "spinal anaesthesia of the upper extremity". It is a popular mode of anaesthesia for various upper limb surgeries, due to its effectiveness in terms of cost, performance, margin of safety and good post operative analgesia.[1]It provides rapid onset, dense anaesthesia of the arm with a single injection.[2] It provides most effective block for upper extremity and also ensures post op analgesia without side effects. It is done at the distal trunk – proximal division level. At this point the brachial plexus is compact and a small volume of local anaesthetic provides rapid onset of reliable blockade of brachial plexus.

Blockade of brachial plexus (C5-T1) will allow for surgical anaesthesia for elbow, forearm and hand surgeries. Several different techniques have been described, but despite modifications to the original Kulenkampff method , the major disadvantage of these 'blind' approaches remains, the small but significant risk of pneumothorax.[3-5] This risk has been reported to be zero in expert hands, other series quote an incidence of pneumothorax as high as 6.1%.[6,7]

When using a landmark technique for regional blockade, poor localization of nerves can result due to anatomical variation or trauma to the region, and result in failed anaesthesia or cause morbidity. In the upper limb, surface ultrasound can clearly identify neural elements of the brachial plexus

as well as surrounding structures.[8-10] Ultrasound guided brachial plexus block gains the advantage of accurate nerve localization, real time visualization of brachial plexus, blood vessels, needle placement, local anaesthetic spread. It minimizes the number of needle attempts.

Various adjuvants, which will prolong the duration of analgesia were tried in many trials with lesser side effects but yet the ideal adjuvant remains undiscovered. Dexmedetomidine is highly selective (8 time more selective than clonidine), [11] and potent α_2 -adrenergic agonist. When used in systemic route it has analgesic, antihypertensive, sedative, and anaesthetic sparing effects. [12] It has been proved that adding Dexmedetomidine to local anaesthetics during peripheral nerve blockade [13] and regional anaesthetic[14]procedures efficacyof the block is improved.

Dexmedetomidine prolongs the block duration and duration of post-operative analgesia when added to local anaesthetic in various regional blocks.[15,16] It has been reported to improve the efficacy of intrathecal, caudal and epidural anaesthesia. Its use in peripheral nerve blocks has recently been described.[17]

Very few trials are done to study the efficacy of using dexmedetomidine as an adjuvant in supraclavicular block. We decided to study the onset and duration of sensory and motor blockade, postoperative analgesia, hemodynamic effects using Dexmedetomidine in combination with local anaesthetics.

AIM OF THE STUDY

- To compare the effects of Bupivacaine- Lignocaine and Bupivacaine- Lignocaine with Dexmedetomidine combination in ultrasound guided Supraclavicular brachial plexus block. The effects will be studied in terms of onset and duration of sensory and motor blockade and duration of postoperative analgesia.

OBJECTIVES OF THE STUDY

- To compare the effects of Bupivacaine- Lignocaine and Bupivacaine-Lignocaine with Dexmedetomidine combination in ultrasound guided Supraclavicular brachial plexus block. The effects will be studied in terms of

  - Hemodynamic responses
  - Onset of sensory blockade and motor blockade
  - Duration of sensory and motor blockade
  - To compare post operative pain levels.
  - Complications / side effects if any

HISTORY OF BRACHIAL PLEXUS BLOCKADE

William Steward Halsted was the first person to perform the brachial plexus block in 1889. He performed the block by directly injecting cocaine in the neck. Percutaneous approach was first described by Hirschel. The classical supraclavicular approach of brachial plexus was first described by Kulenkampff. Winnie and Collins described the subclavian perivascular approach. This approach became popular since it has less chance of pneumothorax than the classical Kulenkampff approach. Raj (Indian origin), an anaesthesiologist practicing in USA developed the infraclavicular approach. In 1949 Accardo and Adriano performed the first axillary approach.

Peripheral nerve blockade remains a well-accepted component of comprehensive anaesthetic care. Its role has expanded from the intraoperative period into the arena of post-operative and chronic pain management. Skilful application of peripheral neural blockade broadens the anaesthesiologists' range of options in providing optimal anaesthetic care. For various upper limb surgeries, supraclavicular brachial plexus block using Winnie's approach is very popular mode of anaesthesia.[1] Due to its effectiveness in terms of cost and performance, margin of safety along with good postoperative analgesia this approach is very attractive. Supraclavicular approach will be the most

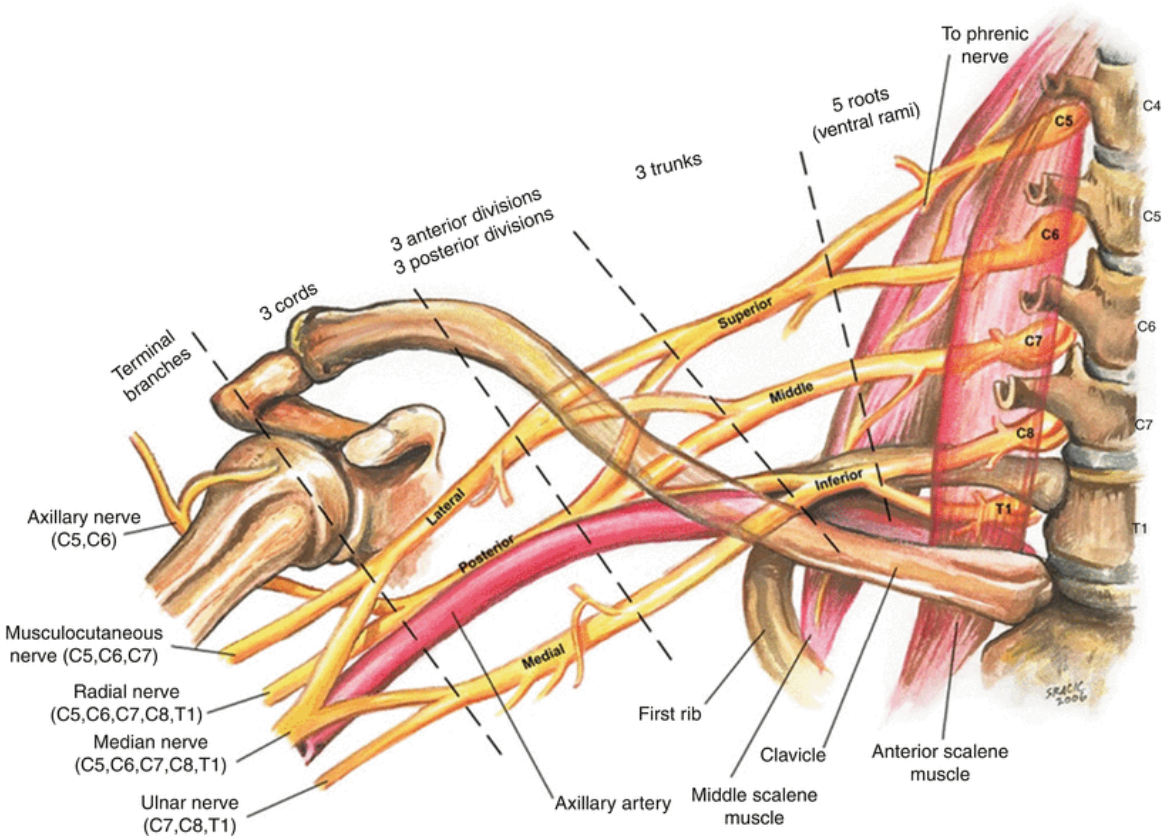
effective for all portion of upper extremity and is carried out at trunk level of brachial plexus.[18]

Knowledge of formation of brachial plexus and its ultimate cutaneous and muscular distribution is absolutely essential for the intelligent and effective use of brachial plexus blockade for upper limb surgeries. Close familiarity with the vascular, muscular and fascial relationships of the plexus is equally essential to the mastery of various techniques, for it is these peri neural structures which serve as the landmark by which needle may accurately locate the plexus percutaneously. In its course from intervertebral foramina to the upper arm, the fibers are composed consecutively of

1. Roots,
2. Trunks,
3. Divisions,
4. Cords and
5. Terminal nerves.

FORMATION OF BRACHIAL PLEXUS

- It is formed by the union of lower four ventral rami of cervical nerves (C5- C 8) and first thoracic nerve (T1) with frequent contributions above from C4 and from T2 below.
- The plexus appears to have a more cephaloid position when the C4 contribution is large and from T2 is lacking- it is termed as **Prefixed**.
- When contribution from T2 is large and from C4 is lacking, the plexus appears to have a caudal position and is termed **Post fixed.**



Roots

- Represent the anterior primary divisions of lower four cervical and first thoracic nerves.

- They enter from the intervertebral foramina, and fuse to form the trunks above the first rib.

Trunks

The roots combine above the first rib and form the three trunks

- C5 and C6 unite and form the "Upper trunk".

- Behind the scalenus anterior, C8 and T1 unite to form "lower trunk" and

- C7 continues as a sole contributor of the "middle trunk".

Divisions

Under the clavicle and over the first rib, the trunks pass out and each one of them divide into anterior and posterior divisions.

Cords

The fibers, as they emerge under the clavicle, recombine to form three cords.

- Lateral to the axillary artery, anterior divisions of upper and middle trunks form "lateral cord".
- Medial to the axillary artery, the anterior division of lower trunk descends and forms the "medial cord".
- "Posterior cord" is formed by the union of the three posterior divisions of all trunks.
- The nerves from medial and lateral cords supply the flexor aspect of upper limbs, while nerves from the posterior cord supply the extensor aspect.

Major terminal nerves:

- The median and lateral cords gives off medial and lateral heads of the Median nerve respectively and they continue as major terminal nerves.
- The lateral cord terminates as Musculo cutaneous nerve
- The medial cord terminates as Ulnar nerve.
- Axillary nerve is given off by Posterior cord and then it continues as “The Radial nerve”.

In summary, it can be considered that brachial plexus begins with five nerves (C5-T1) and terminates in five nerves

- Musculo cutaneous,
- Radial,
- Axillary,
- Median and
- Ulnar Nerves

With its intermediate portions displaying in sets of three that is three main trunks divides into 2 sets of three, they reunite and give rise to three cords. These three cords give off three lateral branches before becoming the major terminal branches of the plexus.

Distribution of brachial plexus:[22]

These are divided into

A) The supraclavicular branches

B) The infraclavicular branches

Supraclavicular branches:-

From the roots:

1. Dorsal scapular nerve – C5

2. Long thoracic nerve of Bell -C5, 6, (7)

3. Nerve to scalenei and longus colli- C5.6, 7.8

4. Branch to phrenic nerve – C5

From the trunks: (C5, 6)

1. Nerve to subclavius

2. Suprascapular nerve

Infraclavicular branches:-

Lateral cord: (C5, 6, 7)

a. Lateral root of median nerve
b. Lateral pectoral nerve
c. Musculo-cutaneous nerve

Medial cord:

1. Ulnar nerve -C7, 8, T1
2. Medial pectoral nerve - C8, T1
3. Medial cutaneous nerve of arm –C8, T1
4. Medial cutaneous nerve of forearm – C8, T1
5. Medial root of median nerve- C8, T1

Posterior cord:

1. Upper and Lower sub scapular nerve – (C5, 6)

2. Radial nerve – (C5-8 & T1).

3. Nerve to latissmus dorsi (Thoraco dorsal nerve) - C6, 7, 8

4. Axillary nerve – (C5, 6)

Supraclavicular branches:

As anaesthesiologists, we must have complete knowledge of distribution of sensory fibers to upper extremities in order to provide surgical anaesthesia appropriate for the procedure. We must also have knowledge of motor nerves in order to provide muscular relaxation and a motionless surgical field and also postoperative persistent neurological defect can be determined by this wisdom.

1. The nerves to scalene and longus colli (C5-8)

They arise from lower cervical ventral rami almost immediately after emerging from the intervertebral foramina after receiving the respective sympathetic nerve contributions. They supply –

- Longuscolli muscle (C2 - C7)
- Anterior scalene muscle (C4-C6)
- Middle scalene muscle (C6-C8)
- Posterior scalene muscle (C6-C8)
- Scalenus minimus muscle (C7-C8).

2. Branch to phrenic nerve: C5

Anterior to the scalenus anterior, a branch from C5 joins the phrenic nerve

3. The Dorsal scapular nerve: C5

It supplies –

- Levator scapulae muscle C3-C5
- Rhomboid minor muscle - C5
- Rhomboid major muscle - C5

4. Long thoracic nerve (C5, 6, 7):

It arises from C5, C6 and C7 in 42% of cases, C5 and C6 crosses serratus anterior in its superior border and continues downwards to the serratus anterior lower border, supplying each of its digitations by its branches. It supplies - serratus anterior muscle. Injury to this nerve causes scapular angle to be drawn medially by unopposed action of rhomboids and levator scapulae. The scapula tends to project (winging of the scapula) when horizontal arm is used for forward pushing movements. The arm cannot be raised above the horizontal level.

Branches from Trunks:

1. The nerve to subclavius (C5-6):

From C5 –C6, nerve descends and reach the subclavius muscle. Accessory phrenic nerve may occasionally be a branch of this nerve. It supplies the subclavius muscle.

2. The Suprascapular Nerve (C5-6):

This nerve arises from superior aspect of the superior trunk and through the suprascapular notch, it enters supraspinous fossa and supplies:

- Supraspinatus muscle C5
- Infraspinatus muscles C5-6.

Occasionally, it gives a sensory branch to the shoulder joint. Because of its position superior to the plexus, this nerve may be stimulated during the subclavian perivascular technique, giving rise to paresthesia of the shoulder, which cannot be relied upon.

Infraclavicular branches:

They comprise all the motor and sensory nerves to the upper extremity.

Branches from the Cords:

A. Lateral Cord:

1) The Musculocutaneous nerve: (C5- 7)

- The major terminal branch of the lateral cord is the Musculocutaneous nerve
- It leaves the plexus after giving off the lateral head of median nerve, and pierces Coracobrachialis muscle.
- It descends downward and laterally between biceps and brachialis, sending motor fibers to the two muscles.
- After piercing the deep fascia just lateral to the tendon of biceps, it continues as the lateral cutaneous nerve of forearm.
- Its muscular supply includes –
    1) Coraco-brachialis muscle (C6,7)
    2) Biceps muscle (C5,6)
    3) Brachialis muscle (C5,6)
- These are powerful flexor muscles of the forearm, paralysis of which causes inability to flex, supinate and abduct the forearm. The arm hangs in medial rotation; forearm is extended and pronated called as**"Erb's paralysis".**

2. Lateral Pectoral nerve (C5, 6, 7)

It is larger than medial pectoral nerve.It supplies the pectoralis major after piercing the clavipectoral fascia. It gives off ramus which supplies some fibers of the pectoralis minor.

3) The Median nerve: (C6, 7, 8, T1)

- The lateral root of median which arises from the lateral cord and medial root of median nerve from the medial cord,joins and forms the median nerve.
- It descends along the course of the Brachial artery.
- In the arm, it descends first on the lateral side of the Brachial artery; and lies deep to the Bicipitalaponeurosis and anterior to brachialis.
- Between the heads of the pronator teres, it enters the forearm, crossing lateral to the ulnar artery.
- It passes between the two heads of Flexor Digitorum Superficialis (FDS) muscle and anterior to Flexor Digitorum Profundus.
- 5 cm proximal to the Flexor Retinaculum (FR), it lies superficially between the tendons of the Flexor Digitorum Superficialis and Flexor Carpiradialis.
- Then it passes deep to retinaculum to terminate into muscular and cutaneous branches.

Muscular branches:-

- Flexor Digitorum Profundus,
- Flexor Pollicis Longus,
- Pronator Quadratus,
- Pronator Teres,
- Flexor Digitorum Superficialis,
- Flexor Carpi Radialis,
- Opponens Pollicis,
- Flexor Pollicis Brevis
- Lumbricals.

Palmar cutaneous branches : Median nerve supplies the lateral two and middle half finger and provides sensory innervations to the dorsal surface of the entire thumb and first three fingers as far as metacarpophalangeal joint.

Articular branches are given to elbow joint and proximal radio ulnar joint. Median nerve injury can occur in forearm, proximal to its muscular and interosseous branches.Flexion of second phalanges of all digits are lost, and of the terminal phalanges of index and middle fingers. Terminal phalanges of other two fingers may be flexed by the part of Flexor Digitorum Profundus, supplied by Ulnar nerve. Proximal phalanges may be flexed by the interossei. The thumb cannot be opposed or abducted, nor flexed at its

interphalangeal joint. Sensation in the area of distribution is lost. Owing to paralysis of intrinsic pollicis muscle and unopposed action of the extensor pollicis longus, an **"apelike" hand** exists. Injury in the mid-forearm may cause only weakness in flexion of the index **("pointing index")** finger, as the branch to Flexor Digitorum Superficialis arises above this level. Injuries proximal to Flexor Retinaculum cause inability to oppose the thumb. Any condition resulting in reduction in the space below the Flexor Retinaculum causes pressure on the nerve in the carpal tunnel, between Flexor Retinaculum and the carpal bones, resulting in pain and slight sensory impairment in the digits supplied and sometimes slight wasting of the thenar muscles. This is called **"carpal tunnel syndrome".**

B. Medial Cord:-

1) Medial head of median nerve (C8, T1)

It joins with the lateral head from lateral cord to form the median nerve.

2) The medial pectoral nerve (C8, T1)

It passes between the axillary artery and vein, joins the lateral pectoral nerve, forming a loop around the artery and pierces the pectoralis minor muscle to supply it. Some fiber pass inferiorly to end in pectoralis major.

3) The medial cutaneous nerve of the arm (C8, T1)

It leaves the axillary sheath high in the axilla and supplies the medial portion of the upper arm till medial epicondyle. Frequently this nerve innervates the lower portion of the arm and upper portion by the intercostobrachial nerve.

4) The medial cutaneous nerve of the forearm (C8, T1)

This nerve supplies the skin over the biceps upto the elbow. It travels down the arm and by dividing into a larger anterior branch and a smaller posterior branch to supply the entire medial aspect of the forearm till the wrist.

5) The ulnar nerve: (C7- T1)

It leaves the axilla and descends along the medial head of triceps groove and pass behind the medial epicondyle of humerus.It is covered by skin and its fascia **("Fussy bone")**.It passes down the ulnar side of the forearm, dividing into superficial and deep terminal branches.

Muscular branches supply (C8, T1)

Flexor Carpi Ulnaris, Flexor Digitorum Profundus- Ulnar Head , Abductor Digiti minimi, Flexor Digiti minimi Brevis, Abductor Pollicis, Palmar Interossei, Dorsal Interossei.

Articular branches to elbow, wrist joint, intercarpal, carpometacarpal and intermetacarpal joints.

Cutaneous branches supply the skin of the medial two and half fingers of the hand. The ulnar nerve may be injured in the forearm leading to impaired abduction; when an attempt is made to flex the wrist. The hand is abducted by the Flexor Carpi Radialis, owing to paralysis of the dorsal interossei, the fingers cannot be spread or flexed at metacarpophalangeal joints or extended at the interphalangeal joints, and the arm assumes a "clawed" shape from the active opposing muscles. Flexion of the fourth and fifth digits is weakened and the thumb cannot adduct. Wasting of the hypothenar muscles will occur. Sensation is lost or impaired on the skin supplied by the nerve.

C. The Posterior Cord: (C5-T1)

1) The upper and lower Sub Scapular nerve

2) The Thoraco Dorsal nerve

3) The Axillary nerve

4) The Radial nerve

Axillary Nerve (C5,C6):

It supplies the deltoid, teres minor and the upper part of the long head of triceps. An articular branch supplies the shoulder joint. The Axillary nerve is liable to injury in its course around the surgical neck of humerus causing paralysis of deltoid and anaesthesia of the skin over the lower part of the muscle. Effective abduction of the arm is not possible.

The Radial Nerve (C5-T1):

- Terminal continuation of posterior cord.
- It inclines along with profunda artery, between long and medial head of the triceps dorsally, then passes obliquely in the musculo spiral groove and then reaches the lower anterior side of the forearm where its terminal branches arise.
- Muscular branches supply the extensor compartment of arm, fore arm and hand.

Sympathetic contribution to brachial plexus:

The segmental preganglionic sympathetic contributions are variable, but generally extend more caudal. The highest contribution is usually T2 with T1 contributing only rarely, while lowest may be as far as T8, T9 or even T10. The post ganglionic contributions are from grey rami communicants from the sympathetic chain.

ULTRASOUND GUIDED SUPRACLAVICULAR BLOCK:

A triangular depression on the lateral neck so called the supraclavicular fossa and is bounded by

- Sternocleidomastoid muscle medially
- The clavicle inferiorly
- The trapezius muscle laterally.

- ✓ After exiting from the interscalene space the brachial plexus enters the supraclavicular fossa
- ✓ The brachial plexus follows supero-lateral relation to subclavian artery.
- ✓ The plexus passes inferior to the clavicle, at midclavicular level and in relation to first rib it lies supero-lateral as they exit the fossa.
- ✓ During the block there is more risk for injury to the pleura since dome of lung lies inferior to the subclavian artery and medial to first rib.

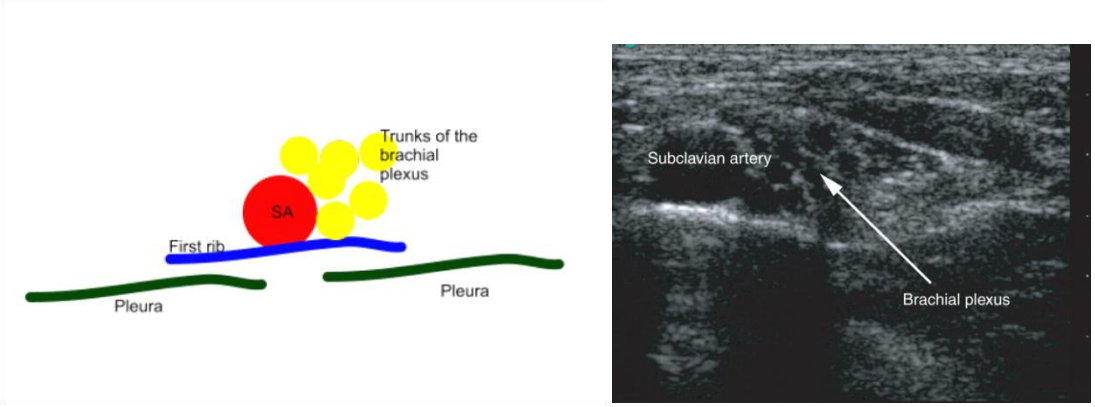
TECHNIQUE

- The patient should be positioned supine and head turned to opposite side of the shoulder.
- A linear high frequency array probe is placed in the region of supraclavicular fossa and oriented superior to the clavicle. (10-18 MHz)

- The subclavian artery should be identified by its brisk pulsations. Brachial plexus with multiple hypo echoic centres lies in relation immediately superior and lateral to the artery as a bunch of grapes. [24]

- Pleura is identified just deep to the artery, by its characteristic movement with breathing.

- The first rib should be identified by its hyper echoic line with posterior shadowing.

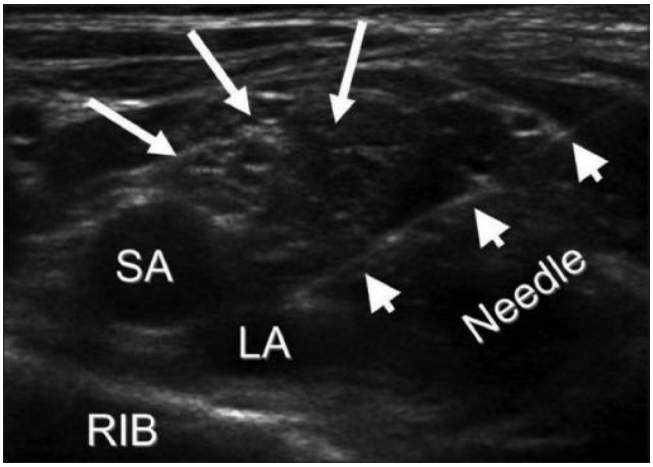


- After keeping the drugs and equipments ready, the skin is anesthetized with 2% Lignocaine.For out of plane technique , the needle is inserted cephalad to the probe in posterior and caudad direction.

- The needle tip is followed and advanced towards thedeep border of plexus and 30ml of local anaesthetic is injected after careful aspiration for blood. The spread can be visualized as it dissects the plexus away from the artery.

- For in plane technique[24], longer needle is inserted lateral to the probe in the direction parallel to beam of the ultrasound. Needle is directed medially towards the artery until the needle tip reaches near to plexus just superior-lateral to the subclavian artery.

- Medial-to-lateral approach is believed to be safe since it reduces the risk of pleural puncture.



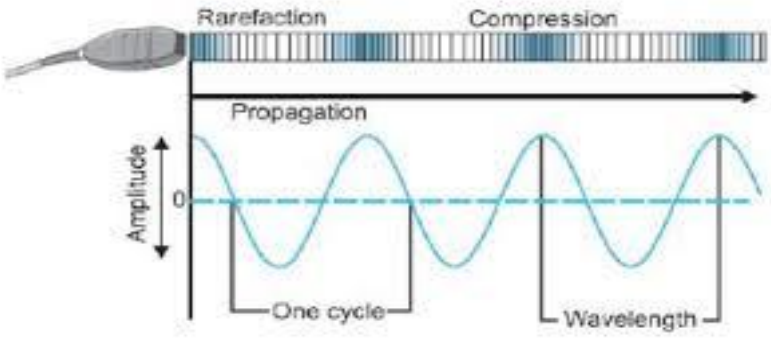
BASIC PRINCIPLES OF ULTRASOUND

Introduction

NM Denny and William Harrop-Griffiths wrote **"*Successful regional anesthesia depends on deposition of the right drug, in the right dose, in the right place".*** To achieve this simplistic goal, practioners of regional anaesthesia used landmark techniques to begin with and later on, peripheral nerve stimulators. The advent of ultrasound, as a guidance tool, has redefined the practice of regional anaesthesia. [25]

The basics of ultrasound:

- Any sound exceeding 20,000 Hz is ultrasound.
- Ultrasound is mechanical sound energy that is transmitted through a medium with alternating areas of compression and rarefaction as a longitudinal wave.
- Piezoelectric crystals that line the patient end of the transducer, upon stimulation by an electric charge, generate the ultrasound wave.
- Properties of ultrasound waves include frequency, wavelength, velocity and amplitude.



- As waves travel deeper into biological tissue, they are attenuated i.e. lose heat. Higher the frequency, more the attenuation, therefore lesser the penetration.[25]

Tissue echogenecity:

- Bright image from the USG probe is labeled *hyperechoic*. Bone, diaphragm, gallstones and pericardium are examples of hyperechoic tissues.

- Weaker, diffuse reflections are labeled as *hypoechoic*. Solid organs are hypoechoic.

- No reflection is labeled as *anechoic*. Fluid and blood filled structures are anechoic[26].

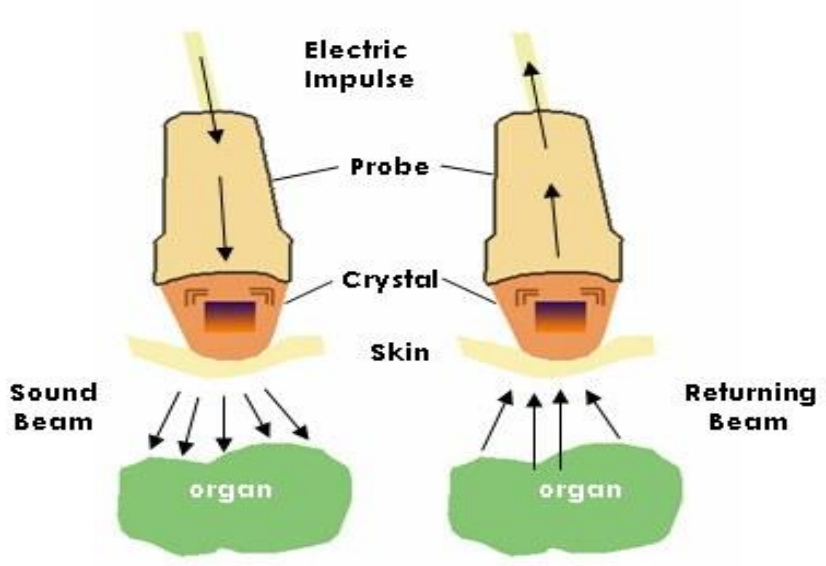
Transducer selection:

- A higher frequency (10-12 MHz) transducer is better suited to visualize superficial structures. These transducers have limited depth of penetration usually less than 4-5 cm.[26]

- A lower frequency (less than 7 MHz) transducer is better for deeper structures.

- A transducer with a curvature has better field coverage than the straight one.

- The transducer, both emits the ultrasound beam, and receives the wave reflected from the imaged tissue, also called the "echo".[27]



- Resolution is the ability of the machine to differentiate two closely related structures as distinctly separate.

- Time Gain Compensation (TGC) amplifies returning echoes from deeper structures so as to present a homogenous image.
- Optimization of image includes

  Selection of the right transducer

  Adequate sterile gel

  Adjusting focus, gain and depth.
- Doppler is a principle that permits quantification of blood flow in vessels.
- Modes of imaging include

  A (Amplitude) mode – hardly used currently

  M (Motion) mode

  B (Brightness) mode – most commonly used.

In-plane approach:

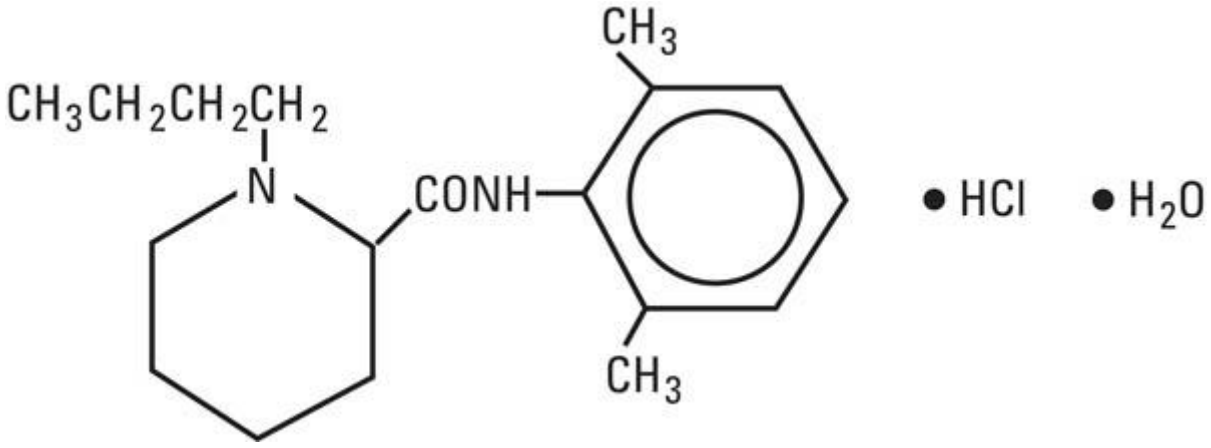
- The needle is inserted few inches away from the transducer, both the needle and the transducer in the same plane.
- This technique is better for needle visualization as the entire needle including the tip can be visualized.
- As the tip of the needle is seen on the monitor, it is easy to deposit the local anaesthetic solution as close to the sheath as possible thereby reducing the requirement of large volume injections.

Out of plane approach:

- Here the needle is advanced perpendicular to the USG probe making the needle visualization difficult.
- The best way to ascertain the position of the needle is by injecting a small volume of local anaesthetic solution and checking the spread on the monitor.

BUPIVACAINE

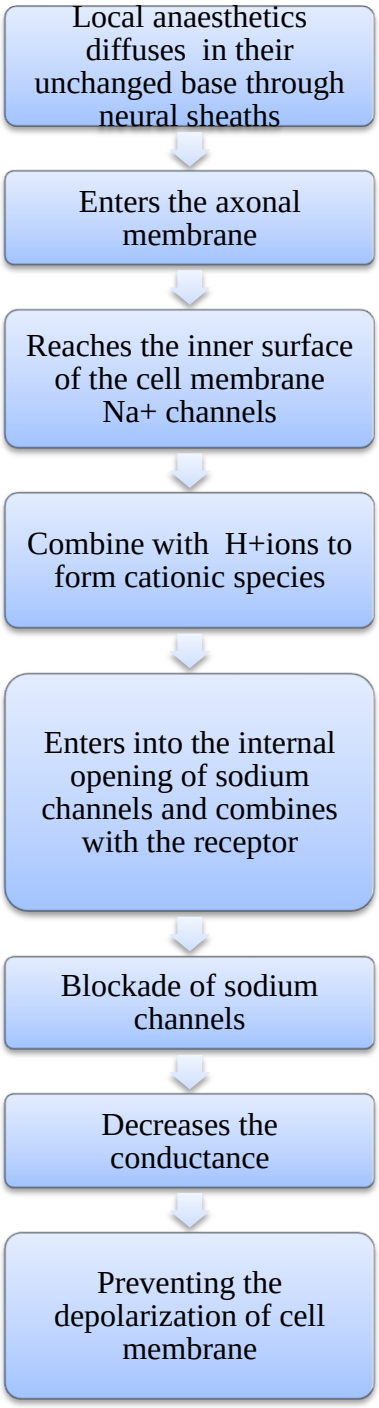
- Bupivacaine hydrochloride belongs to amide group of local anaesthetic.
- It has the following structural formula



PHARMACODYNAMIC PROPERTIES

- Bupivacaine is a amide-type, long acting.
- It provides surgical anaesthesia
- Sensory block is more pronounced at lower doses than motor block.
- When compared with lignocaine the onset of blockade is slower.

Mode of action:



Effects:

- **CVS:** It is cardio toxic and it binds to myocardial proteins in addition to blocking cardiac sodium channel. It decreases the rate of increase of phase 0.
- It produces hypotension and eventually cardiac arrest.

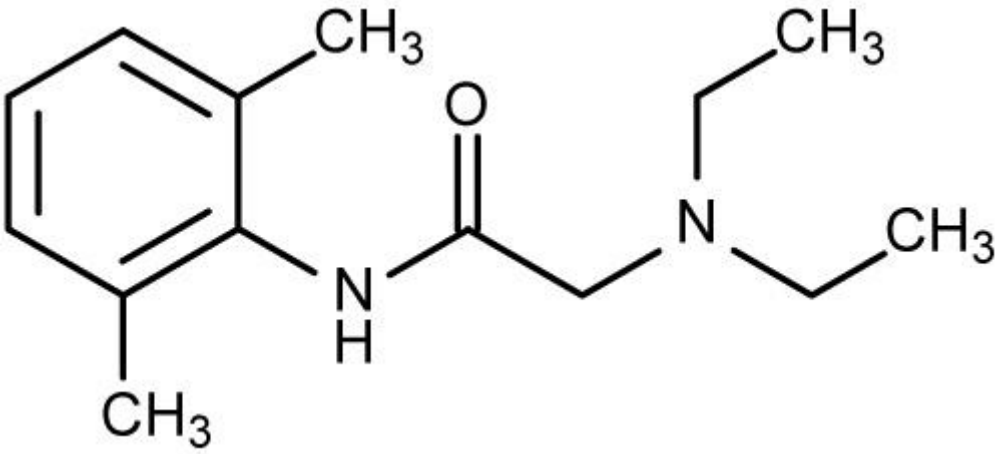
PHARMACOKINETIC PROPERTIES

- pKa of Bupivacaine is 8.2
- Elimination half-life is 2.7 h.
- It is 95% protein bound in plasma to albumin and alpha 1 acid glycoprotein.
- Volume of distribution is 21L

METABOLISM:

- Occurs in liver by N-alkylation, primarily to pipecoloxylidide, N-desbutyl Bupivacaine and 4 –OH Bupivacaine.
- Bupivacaine readily crosses the placenta.
- About 5% excreted in urine as pipecooxyldide, 16% excreted unexchanged.

LIDOCAINE

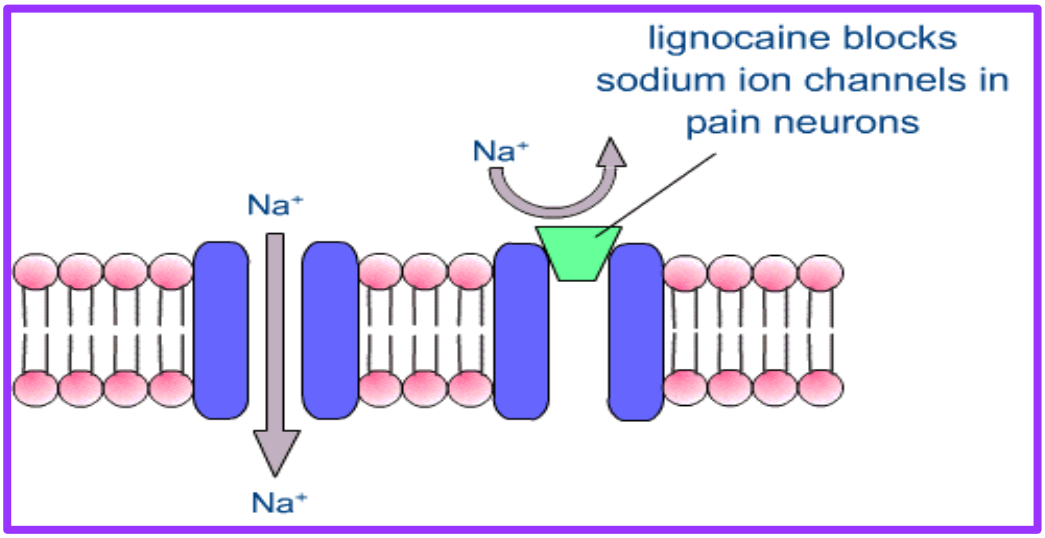


- Swedish chemist Nils Lofgren was the first person who synthesized Lignocaine under the name Xylocaine 1943.
- Its chemical name is 2-(diethyl amino)-N-(2, 6-dimethylphenyl) acetamide.
- It belongs to amide group of local anaesthetic drug.
- Its pKa is 7.86
- Half life: 1.6 hrs(~90 min)
- Distribution: Lipophilic, widely distributed into body
- pH of plain solution-6.5
- pH of vasoconstrictor containing solution-5.0-5.5
- Onset of action –rapid
- Pregnancy classification-B
- Effective dental concentration-2%

- Protein binding: 60-80 %
- Half-life 60 to 120 min
- The maximum recommended dose of Lidocaine with epinephrine is 7.0mg/kg body weight for adult patient, not to exceed dose of 500mg.
- 3mg/kg body weight dose of lidocaine without a vasoconstrictor,not exceeding the dose of 300 mg for peripheral nerve block.

MECHANISM OF ACTION

- It blocks the sodium (Na+) channels in the cell membrane and in neurons, it alters depolarization
- Hence there occurs failure in transmission of an action potential leading to its anaesthetic effects.



PHARMACOKINETICS

- **Absorption:**

Absorbed rapidly after parenteral administration & from GIT & Respiratory Tract

- **Metabolism:**

Metabolized in the liver

- **Excretion:**

  - Metabolites and unchanged drug are excreted by the kidneys in the urine.
  - Monoethyl glycine xylidide and glycine xylidide are the key active metabolites

EFFECTS ON ORGANS:

CVS:

- In low concentration, it decreases the rate of rise of phase 0 of cardiac action potential by blocking inactivated sodium channel.
- This results in shortened effective refractory period.

RESPIRATORY SYSTEM:

- Suppresses the airway reflexes when given intravenously.

CNS:

- Biphasic effects in the CNS: Initially excitation –> light headedness dizziness, visual and auditory disturbances, seizure activity,occurs due to inhibition of inhibitory interneuron pathway in the cortex.

- With increasing doses – depression of both facilitatory and inhibitory pathway leading to CNS depression.

Toxicity:

- Intrinsically less toxic than Bupivacaine.
- Usually happens when accidental injection intravascularly or when the dose exceeds the therapeutic dose.
- Twitching
- Tremors
- Seizures
- Respiratory depression
- Cardiovascular depression
- Tachypnoea

DEXMEDETOMIDINE

Dexmedetomidine is the d-enantiomer of medetomidine, used for sedation and analgesia in veterinary medicine for many years. Introduced in 1999 and used as a short-term sedative of less than one day for mechanically ventilated critical care patients. Nowadays, it is used as sedative and adjuvant analgesic in the OT, sedation in diagnostic and procedure units in adult and paediatric patients.

Characteristics:

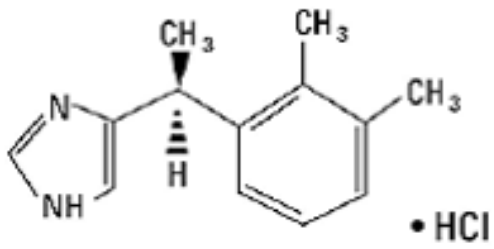
- It has a highly selective specificity for α2 receptor (α2/α1 1600:1) whereas clonidine[29] has a ratio of only 200:1 and therefore it is an absolute α2 agonist.
- It belongs to α2 receptor agonists

Chemical structure of Dexmedetomidine

Dexmedetomidine hydrochloride is the S-enantiomer of medetomidine

Molecular weight: 236.7

The structural formula is:



Metabolism and Pharmacokinetics

- Dexmedetomidine is rapidly distributed and extensively metabolized in the liver and excreted in urine and faeces.
- It undergoes conjugation predominantly.
- Protein binding capacity of Dexmedetomidine is 94%
- It has profound effects on cardiovascular variables
- The elimination half-life is 2 to 3 hours

Pharmacology

- Dexmedetomidine is a nonselective α2 agonist.[29]
- α2 adrenoreceptors are membrane-spanning G proteins.
- Acts by inhibition of adenylate cyclase and ion channels modulation.
- There are three subtypes of α2 adrenoreceptors namely α2A, α2B and α2C. [30]
- The α2A receptors are found in peripheral blood vessels whereas α2B and α2C are found in the brain and the spinal cord.
- Postsynaptic α2 adrenoreceptors in peripheral vessels causes vasoconstriction, whereas presynaptic α2 adrenoreceptors causes inhibition of the release of norepinephrine
- These receptors will produce

✓ Sympatholysis,

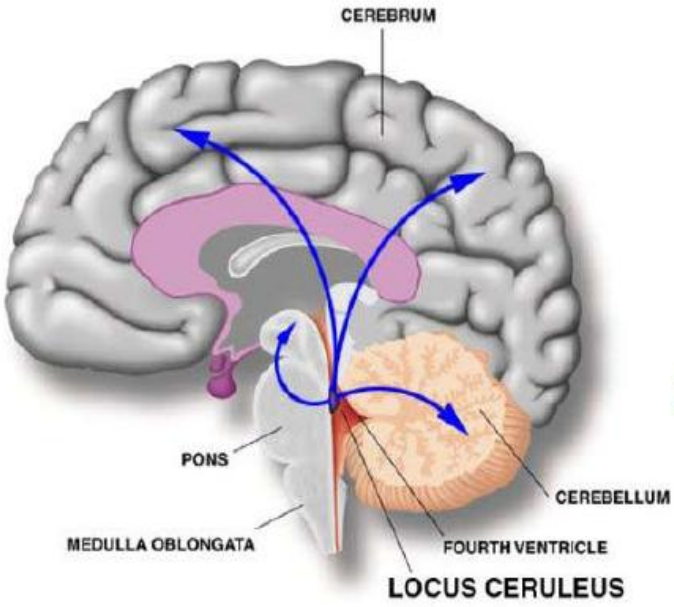
✓ Anti-nociception effects of α2 adrenoreceptors.

✓ Sedation

Atipamezole:

This is a **s**pecificα2 antagonist. Dexmedetomidine effects are reversed at 75-150µg /kg dose (Sympatho activation). This not approved by US FDA at present because altepamezole is still under trial stages only.

Effects on the Central Nervous System



α_{2A}-adrenoceptors in *locus coeruleus* in the brain stem activated

↓

Ca^{2+} channel inhibition and K^{+}channel opening

↓

hyperpolarisation of excitable neural cells

↓

sedation / anaesthesia

They are as follows:

1. Sedation

2. Anxiolysis

3. Hypnosis

4. Analgesia

5. Sympatholysis.

Sedation

- Sedation is caused due to α2 agonism in the locus caeruleus
- The quality of sedation produced by Dexmedetomidine seems different compared with that produced by other sedatives acting through the GABA systems.
- Even though there is marked sedation, the risk of respiratory depression is very minimal and hence the drug has high safety margins.

Analgesia

The main site of action is the spinal cord.

Cardiovascular effects:

- It causes bradycardia, hypotension and reduced myocardial contractility
- By developing highly selective α agonists, it has been hoped to decrease some of these adverse cardiovascular effects and to maximize the desirable hypnotic-analgesic properties.
- Dexmedetomidine shows a characteristic biphasic response in hemodynamics.

- Acute injection will produce an initial increase in blood pressure, probably due to its vasoconstrictive effects by stimulating peripherally located α2 receptors.
- Heart rate and blood pressure declines approximately to 15% below the baseline by 1 hour.
- After IM injection of the same dose, the initial increase in blood pressure was not seen and HR and BP remained 10% of baseline value.
- Infusion of Dexmedetomidine in volunteers has also been shown to result in a compensated reduction in systemic sympathetic tone without changes in baroreflex sensitivity.
- It also blunts the heart rate and systemic sympathetic activation owing to sweating, but is less effective in blunting cardiac sympathetic response to shivering.
- Hypotension and bradycardia occurs mainly due to the loading dose.
- Giving less than 0.4 µg/kg of loading dose and giving slowly over 20 minutes will reduce the severe fall in blood pressure.
- A frequently reported side effect of Dexmedetomidine has been a dry mouth. Dry mouth is due to a decrease in saliva production.

Uses

- Intubated patients in the ICU.
- It is very useful in peripheral nerve blocks because of its proven effects like sedation, anxiolysis, analgesia, and sympatholysis with less respiratory depression,

REVIEW OF LITERATURE

History of brachial plexus block

The first brachial plexus block was performed by **William Stewart Halsted** in1885, less than a year after **Koller** demonstrated the anaesthetic properties of cocaine on the eye of a patient. Halsted exposed the roots surgically under local Infiltration and injected each of them with a small amount of dilute cocaine (0.1%) intra neutrally under direct vision. Only about 0.5 ml of local anaesthetic was required to produce complete anaesthesia. In 1897, **Crile** used a similar technique in which the plexus was exposed under local anaesthesia. Just behind the sternomastoid muscle cocaine was injected into the nerve trunks under direct vision which was done as a therapeutic measure in a 12 year old boy who had developed tetanic spasms following a compound fracture of the forearm, later the technique was used to provide anaesthesia for upper arm surgeries.

1. Sandhya Agarwal et al[31] concluded that , Dexmedetomidine when added as an adjuvant to Bupivacaine in Supraclavicular brachial plexus block , the time of onset of the block shortens.The duration of motor and sensory block and postop analgesia prolongs significantly

2. In a study by Saritaet al [28], they concluded that when compared with clonidine, Dexmedetomidine when added with Bupivacaine prolongs

the duration of motor and sensory block, the postop analgesia duration and hence the quality of block

3. Anjan Das et al[32] in a double blinded study with Ropivicaine and Dexmedetomidine for Supraclavicular brachial plexus block, concluded that addition of Dexmedetomidine produces significant increase in the duration of motor and sensory block and also the time of usage of first analgesic.

4. Krishna Chaithanya et al[33] conducted similar study with Bupivacaine –Lignocaine Adrenaline and Bupivacaine, Lignocaine with Adrenaline with Dexmedetomidine, they concluded that Dexmedetomidine, a potent α2 selective agonist shortens the motor and sensory block onset time and the duration of motor and sensory block was prolonged.

5. In a study of Amany S et al [34], 0.75µg/kg of Dexmedetomidine + plain Bupivacaine and plain Bupivacaine were compared in USG guided infraclavicular block. They found that Dexmedetomidine reduced the time of onset of motor and sensory block, increased the duration of postop analgesia, reduced the VAS pain scores and finally decreased the supplemental needs of opioids.

6. Kenan et al [35] concluded that adding Dexmedetomidine to Levobupivacaine in axillary brachial plexus block, onset time is

shortened , duration of motor and sensory block increased and also the time for first analgesic use, and reduces analgesic requirements with nil side effects.

7. Aliyeesmaoglu et al [36] (2010) evaluated the effect of adding Dexmedetomidine (100µg) to 0.5% Levobupivacaine for axillary blockade. They concluded that with Dexmedetomidine, onset time was shortened, duration of motor and sensory block was increased and also the time for first analgesic use.

8. Obayahet al [37] studied the effect of Dexmedetomidine 1µg/kg when added to 0.25% Bupivacaine and on the duration of postoperative analgesia in children following cleft palate repair. Conclusion of their study was Dexmedetomidine provides good postop analgesia by 50% with no significant side effects.

9. RachanaGandhi [38], Alka Shah and Patel conducted a prospective double blind study to compare the postoperative analgesic property and safety of Dexmedetomidine (30µg) in brachial plexus blockade along with Bupivacaine (0.25%). Duration of analgesia and incidence of various complications following the procedure were observed. It was concluded that onset of motor and sensory blockade was faster with better hemodynamic stability and greater postoperative analgesia.

MATERIALS AND METHODS

Source of data:

After ethical clearance, patients undergoing elective upper limb surgery in Coimbatore Medical College and Government hospital were included in our study.

Study period:

July 2015 – July 2016

Study Design:

Interventional study

Study Subjects:

Sample size: 60

Inclusion criteria

- Patients belonging to age group 18-60 years
- ASA grade I and grade II
- Patients undergoing elective operative procedure for upper limb surgeries (i.e. Elbow, forearm and hand surgeries.)

Exclusion criteria

- Patients who refuse.
- Patients with history of bleeding disorders.
- Patients with local infection at the site of block.
- Patients with documented neuromuscular disorders.
- Patients with respiratory compromise.
- Patients with known allergy to local anaesthetic drugs.

Materials required:

- Antiseptic for skin disinfection
- Sterile drape
- 20 ml syringe
- Needle : 50 or 80 mm needle with 50 cm extension tubing
- 0.5% Bupivacaine (15ml)
- 1% Lignocaine (15ml)
- Dexmedetomidine 0.75 μg/kg
- 1–2 mg of Midazolam intravenous (IV)
- 50μg of Fentanyl IV
- 4 ml of 1% Lidocaine SC
- Ultrasound machine with a high frequency probe (6-15 MHz)
- Ultrasound probe cover
- Sterile ultrasound gel

METHODOLOGY

60 patients were randomly allotted into 2 groups, group I and group II. All the patients received injection Midazolam 0.05mg/kg and injection Fentanyl 0.5 µg/kg intravenously 15 minutes before the procedure. The basal HR, SBP and DBP and SpO2 were recorded. An IV cannula of size 18 gauge (G) was inserted in non-operated arm and lactated Ringer's solution was started.

Supraclavicular brachial plexus block was given with the patient placed in supine position with head turned to opposite side. The probe of the ultrasound was placed in the supraclaviclar fossa and brachial plexus was identified. It was approached using a 22G, 55mm needle:

Group I: Patients received 15ml of 0.5% Bupivacaine + 15ml of 1% Lignocaine

Group II: Patients received 15ml of 0.5% Bupivacaine + 15ml of 1% Lignocaine + Dexmedetomidine 0.75 µg/kg

The sensory and motor blockade onset and duration were studied. Sensory block was assessed by pin prick test using a 3point scale:

0 = normal sensation

1 =loss of sensation of pin prick

2 = loss of sensation of touch

Motor block was determined according to the modified Bromage scale scale:

Grade 0: Normal motor function with full flexion and extension of elbow, wrist, and fingers

Grade 1: Decreased motor strength with ability to move the fingers only

Grade 2: Complete motor block with inability to move the fingers

The loss of pinprick sensation was checked every 3 minutes till the onset of loss of sensation and then every15min till the regain of sensation. The motor blockade was assessed every 3 minutes till the loss of movements and then every 15min till they regained movements. HR, SBP, DBP, and SpO2 were monitored every 15 min.

Onset of action: Sensory & Motor blockade

Sensory block: The time interval between administration of local anaesthetic solution to loss of pin prick sensation.

Motor Block: The time interval between administration of local anaesthetic solution to loss of movements.

Duration of blockade:

Sensory block: Time interval between loss of pin prick sensation to appearance of pin prick sensation.

Motor block: Time interval between loss of movements to appearance of the movements.

4) Duration of analgesia

Duration of analgesia was recorded with the help of Visual Analog Scale (VAS) which ranges from 0 - 10.This scale was noted per every 60 minutes post-operatively till it comes to 5. Then the rescue analgesia was provided. The drug used was Inj. Diclofenac sodium (1.5 mg/kg) intramuscularly. The time of administration was recorded.

5) Complications:

All patients were monitored for complications (if any) during the intra-operative period and up to 48 hours post-operatively. The observations and particulars of each patient were recorded in the proforma enclosed.

OBSERVATION AND RESULTS

Age distribution of patients studied

Age Distribution of Patients Studied		
Age in Years	**No of Patients**	**%**
<30	22	36.67
31-40	17	28.33
41-50	12	20
51-60	9	15
Total	60	100

Table 1: Age Distribution of Patients Studied

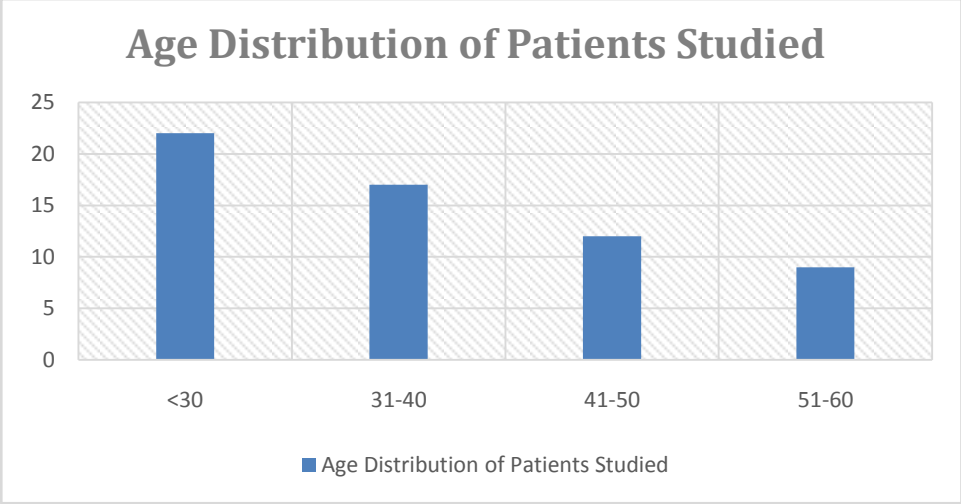


Figure 1: Distribution of Patients according to age

Inference:

In Study group, the maximum age group was less than 30years.

Gender Distribution of Patients Studied

Gender Distribution of Patients Studied		
Gender	**No of Patients**	**%**
Male	45	75
Female	15	25
Total	60	100

Table 2: Gender Distribution of Patients Studied

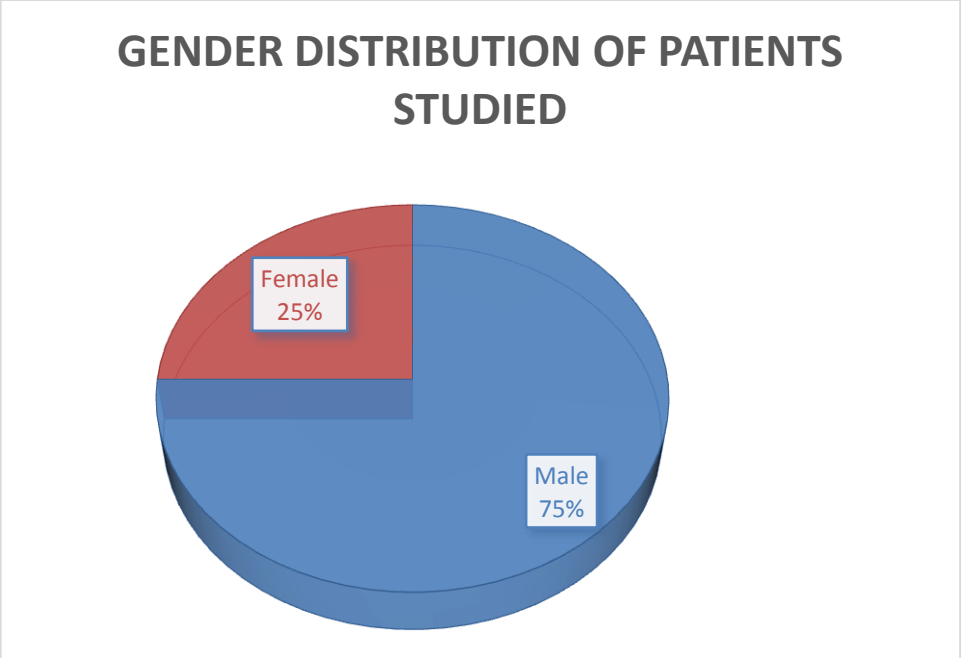


Figure 2: Distribution of Patients according to Gender

Inference:

In our Study group, males are dominant with 75%.

Descriptive Analysis Intervention Group

Treatment Group	No of Patients	%
Group A (0.5%Bupivacaine (15ml) and 1% Lignocaine (10ml))	31	51.67
Group B (0.5%Bupivacaine (15ml) and 1% Lignocaine (10ml))+ Dexmedetomidine (0.75mg/kg))	29	48.33
Total	**60**	**100**

Table 3: Descriptive Analysis Intervention Group

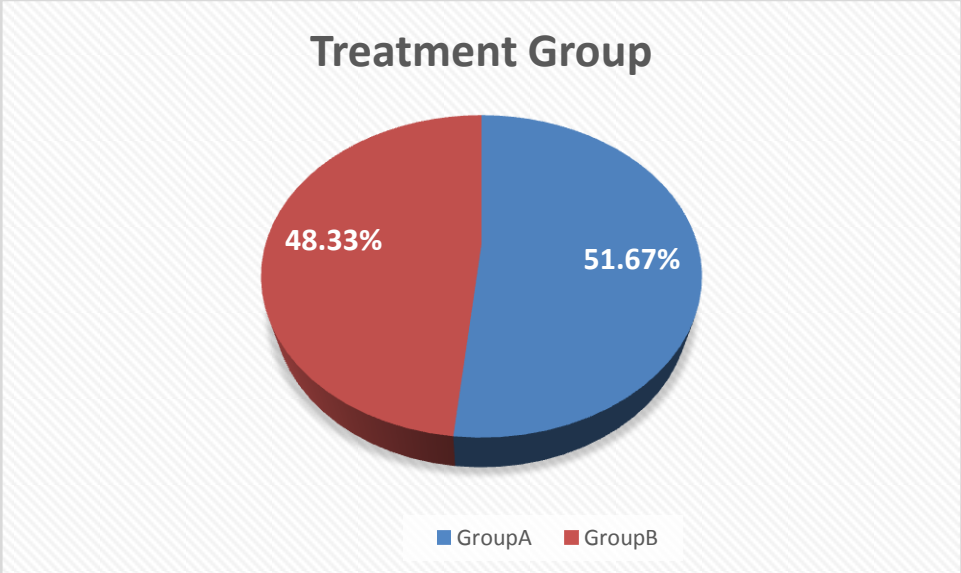


Figure 3: Descriptive Analysis Intervention Group

Descriptive Analysis of Socio Demographic parameters in study groups

Parameter	Group A	Group B
Age	39.29	32.93
Sex		
Male	38.33%	36.67%
Female	13.33%	11.67%
Anthropometry		
Weight	67.42	68
Height	1.69	1.64

Table 4: Descriptive Analysis of Socio Demographic parameters

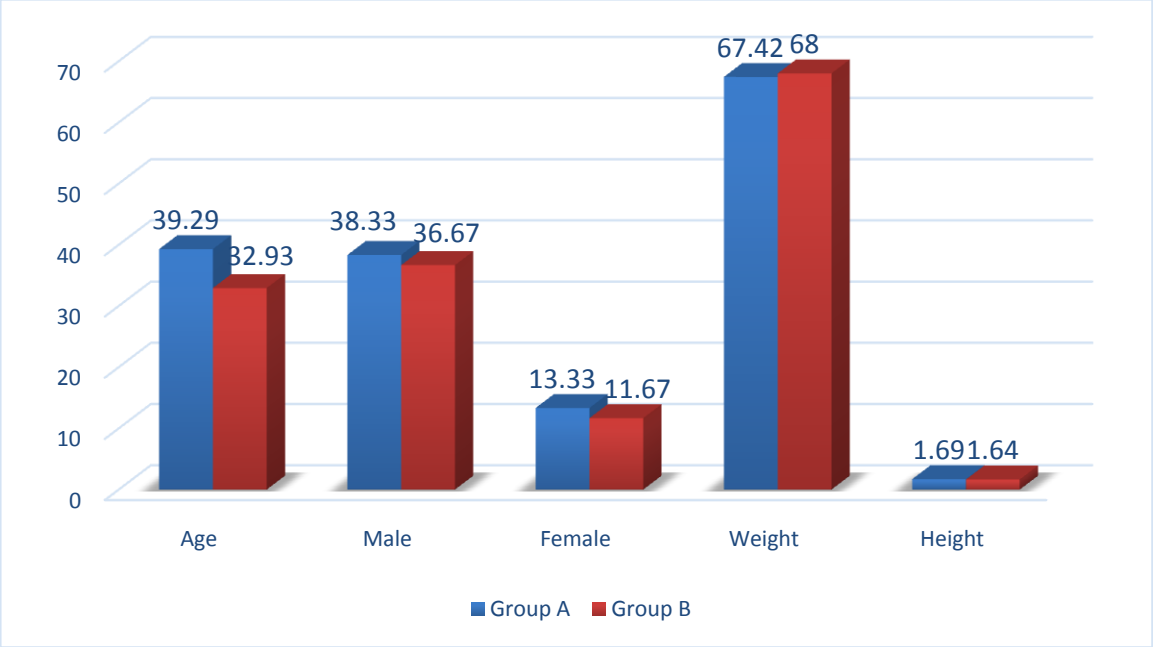


Figure 4: Descriptive Analysis of Socio Demographic parameters

Inference:

With reference to the above data, there is a minor difference, existed between mean age and proportion.

Hemodynamic parameters - Heart rate

Heart Rate					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	82.13	-5.35	0.161	-12.84	2.13
Group B	87.48				

Table 5: Heart Rate

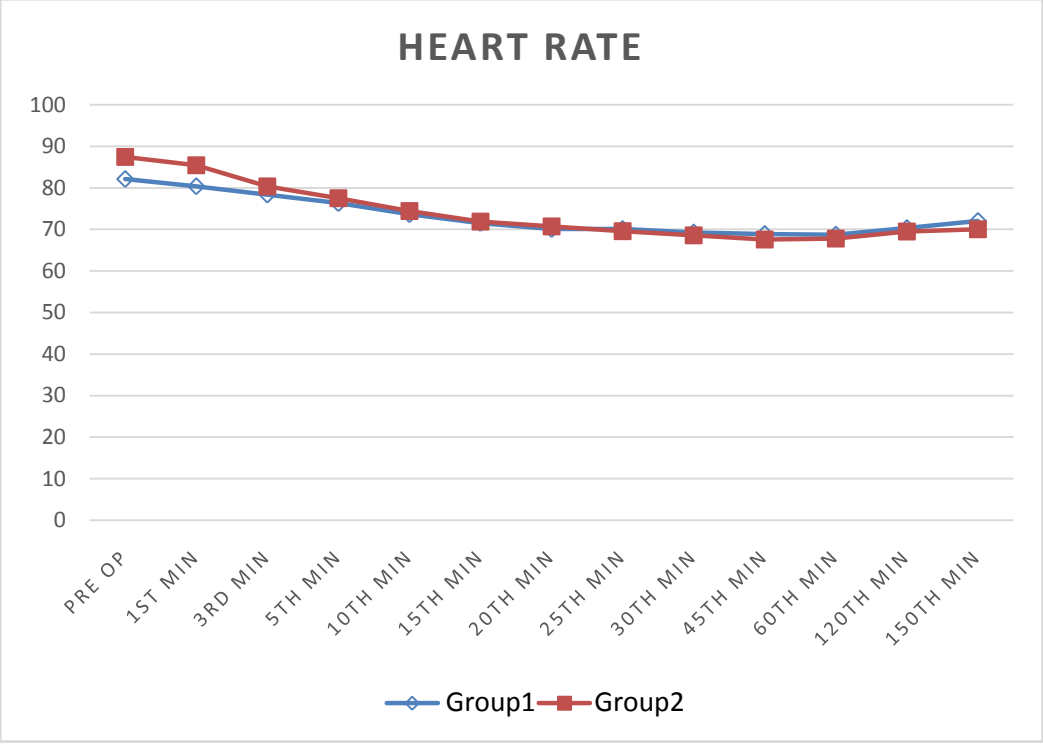


Figure 5: Heart Rate

Hemodynamic parameter- Systolic BP

Systolic BP					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	127.06	-13.15	0.0047	-21.9938	-4.291
Group B	140.21				

Table 6: Systolic BP

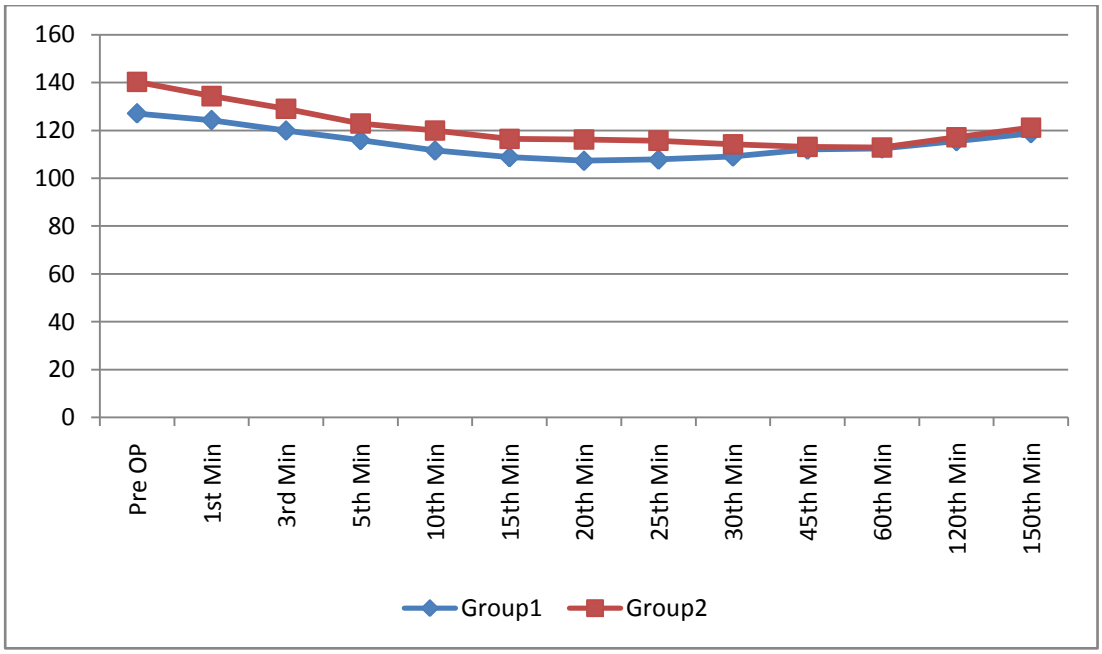


Figure 6: Systolic BP

Hemodynamic parameter- Diastolic BP

Diastolic BP					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	82.03	-6.31	0.0157	-11.24	-1.39
Group B	88.34				

Table 7: Diastolic BP

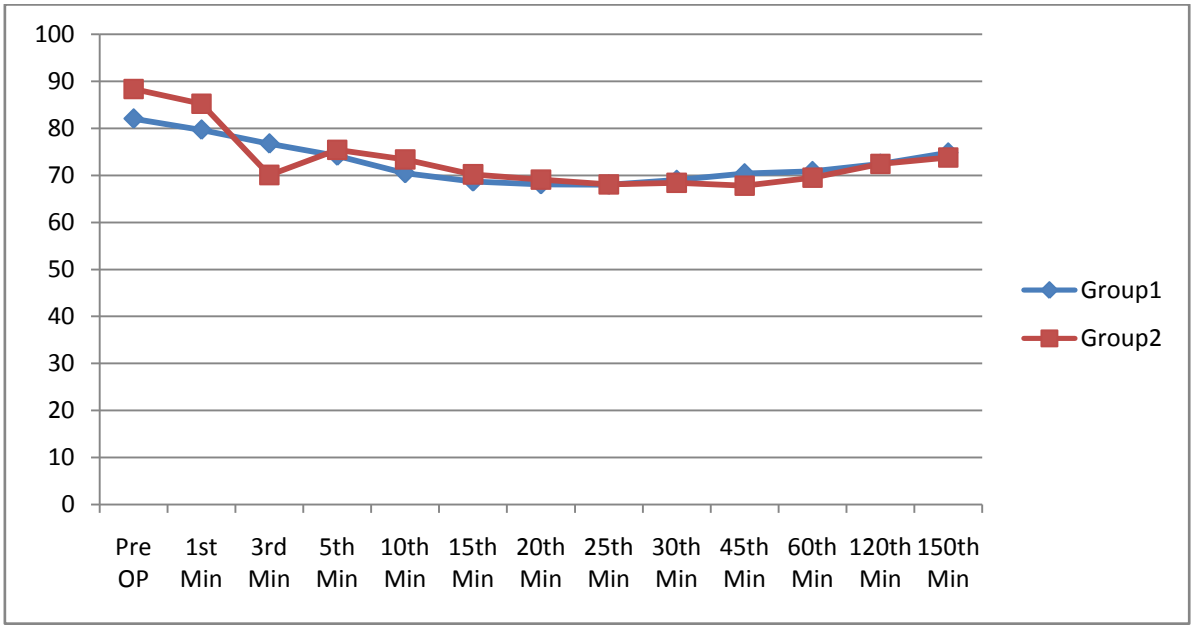


Figure 7: Diastolic BP

Hemodynamic parameter-Respiratory Rate

Respiratory Rate					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	13.29	-0.95	0.047	-1.8712	-0.0309
Group B	14.24				

Table 8: Respiratory Rate

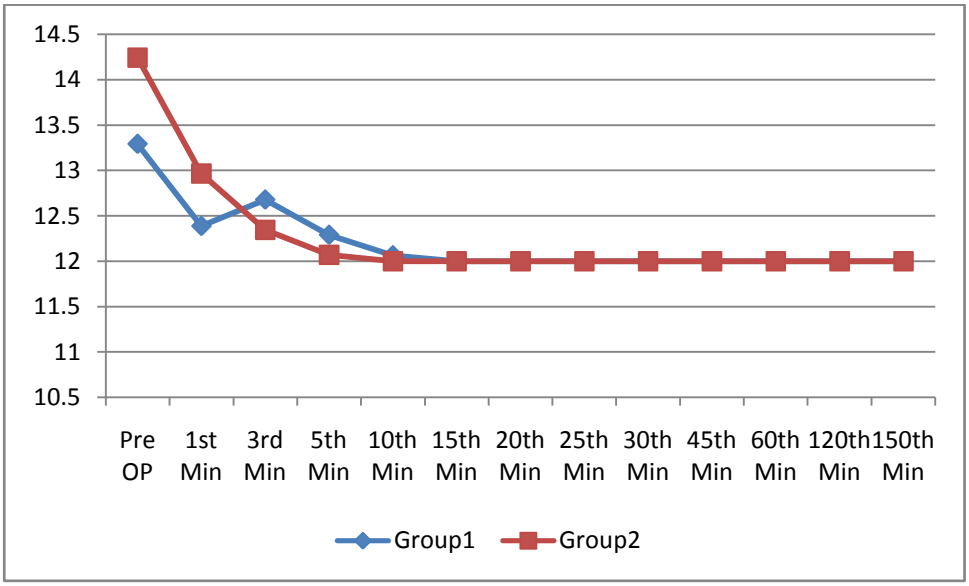


Figure 8: Respiratory Rate

Hemodynamic parameter- SPO2

SPO2					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	99.94	0.11	0.199	-0.064	0.2798
Group B	99.83				

Table 9: SPO2

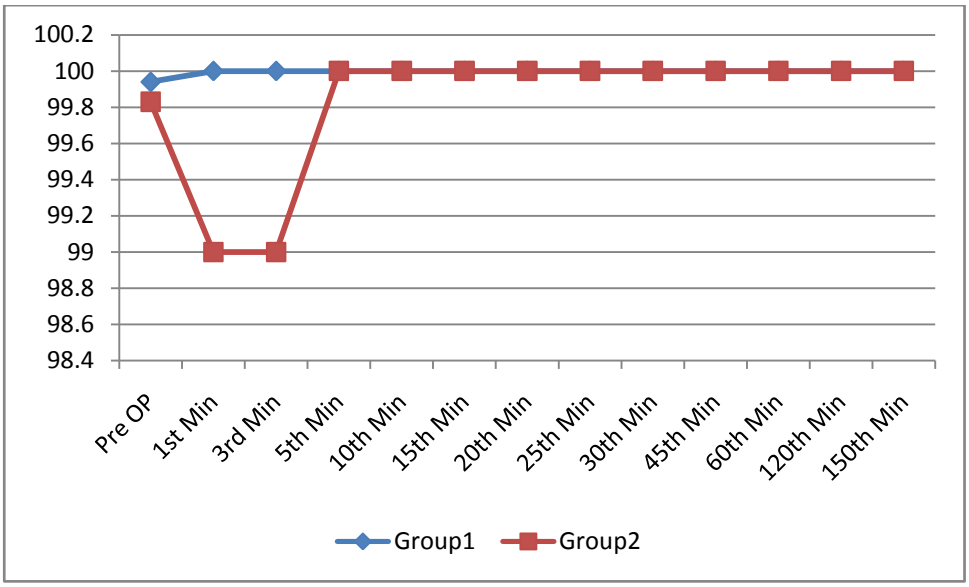


Figure 9: SPO2

Comparison of Onset and Duration of Anaesthesia in both study groups

Table 10: Onset of Sensory Block

Onset of Sensory Block					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	9.51	5.27	< .00001	-5.51	-4.11
Group B	4.24				

Onset of Motor Block:

Onset of Motor Block					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	10.55	5.34	< .00001	-5.51	-4.12
Group B	5.21				

Table 11: Onset of Motor Block

Duration of Sensory Block

Duration of Sensory Block					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	7.84	-3.4	< .00001	-3.7108	-3.0546
Group B	11.23				

Table 12: Duration of Sensory Block

Duration of Motor Block

Duration of Motor Block					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	7.04	-2.47	< .00001	-2.7416	-2.213
Group B	9.51				

Table 13: Duration of Motor Block

Inference:

The duration of sensory blockade (mean difference -3.4, p value <0.00001), and motor blockade (mean difference -2.47 hours, p value <0.00001) and both these findings were statistically significant.

Comparison of other related parameters in both study groups

Time taken for full sensory recovery					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	9.58	-4.14	< 0.00001	-4.5662	-3.7224
Group B	13.72				

Table 14: Time taken for full sensory recovery

Table 15: Time taken for full Motor recovery

Time taken for full Motor recovery					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	8.26	-2.43	< 0.00001	-2.7599	-2.1127
Group B	10.69				

Inference:

The duration of full sensory recovery (mean difference -4.14, p value <0.00001), and full motor recovery (mean difference -2.43 hours, p value <0.00001) and comparatively time taken were longer in group B compared to group A. These differences were statistically significant.

Comparison of effectiveness of Analgesia in both study groups

Duration of complete Analgesia (VAS at 0)					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	7.84	-3.39	< 0.00001	-3.7108	-3.0546
Group B	11.23				

Table 16: Duration of complete Analgesia

Table 17: Duration of effective Analgesia

Duration of effective Analgesia (VAS at 4)					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	9.65	-4.19	< 0.00001	-4.6143	-3.7669
Group B	13.84				

Table 18: Time of First pain Medication

Time of First Pain Medication					
Group	**Mean**	**Mean Difference**	**P Value**	**95% CI (Lower)**	**95% CI (Upper)**
Group A	9.85	-4.18	< 0.00001	-4.6282	-3.7479
Group B	14.03				

Inference:

Duration of complete Analgesia and time of first rescue pain medication between the study groups are statistically significant. All these parameters were longer in group B, compared to group A.

DISCUSSION

In our study, a mixture of Lignocaine and Bupivacaine was used for Group A and Dexmedetomidene with Lignocaine and Bupivacaine for Group B patients. Ultrasound which has become a useful tool was used in our study.

Age group:

In our study, age group of 18-60 years posted for upper limb surgery were included Patients were randomly allocated into Group A and Group B.

Exclusion Criteria:

Patients with a history of significant cardiovascular, alcoholic, neurological, pregnancy women, lactating women, patients with obesity, diabetes, and peripheral vascular disease were not included in this study.

Anaesthetic agent and dose

Group 1	0.5% Bupivacaine (15ml) and 1% Lignocaine (15ml)
Group 2	0.5% Bupivacaine (15ml) and 1% Lignocaine (15ml) + Dexmedetomidine(0.75mg/kg)

The Heart Rate, Respiratory Rate, Non-Invasive arterial Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Peripheral Oxygen Saturation (SpO2) were recorded.

Duration and Onset of action

In a study of Sarita et al (2012)[28] where clonidine and Dexmedetomidine were compared in supraclavicular block, mean onset time of motor block in clonidine was 4.65 minutes whereas in Dexmedetomidine group was 3.87 minutes. The mean onset time of sensory block in clonidine group was 2.3 minutes whereas in Dexmedetomidine group was 1.7 minutes.

In a study by Kenan et al [35], when Dexmedetomidine added with Levobupivacaine in axillary block, there was no shortening of onset of motor block whereas the onset of sensory block was shortened.

Keshav Govind Rao et al (2014)[39] and Rachana Gandhi et al studied the effects of Dexmedetomidine Dexmedetomidine with Bupivacaine in supraclavicular block. They found that there was significant reduction of onset in the duration of motor and sensory blockade.

In our study, the duration of sensory blockade (mean difference -3.4, p value <0.00001), and motor blockade (mean difference -2.47 hours, p value

<0.00001) and both these findings were statistically significant. It indicates that duration of sensory blockade and motor blockade in Group B is prolonged than Group A.

The mean duration time of sensory block in Group A (plain Bupivacaine and Lignocaine) was 7.84 minutes whereas in Bupivacaine and Lignocaine with Dexmedetomidine was 11.23 minutes. The mean duration time of motor block with plain Bupivacaine and Lignocaine was 7.04 minutes whereas in Bupivacaine and Lignocaine with Dexmedetomidine group was 9.51 minutes.

The onset of sensory blockade (mean difference -5.27, p value <0.00001), and motor blockade (mean difference -5.34 hours, p value <0.00001) and both these findings were statistically significant. It indicates that onset of sensory blockade and motor blockade in Group B is quicker than in Group A.

The mean onset time of sensory block in Group A (plain Bupivacaine and Lignocaine) was 9.23 minutes whereas in Bupivacaine and Lignocaine with Dexmedetomidine was 4.41 minutes. The mean onset time of motor block with plain Bupivacaine and Lignocaine was 10.22 minutes whereas in

Bupivacaine and Lignocaine with Dexmeditomidine group, it was 5.41 minutes.

Duration of analgesia

Amany S. et al [40]compared Bupivacaine alone and Bupivacaine with Dexmeditomidine in ultrasound-guided infraclavicular brachial plexus block. They reported that onset time was shortened, duration of motor and sensory block were increased and also the time for first analgesic use in Dexmeditomidine group.

Sarita et al [28], Kenan et al [35]and Aliye Esmaoglu et al[36] also reported similar effects in terms of prolongation of the duration of sensory and motor blocks.

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In our study time, the duration of complete Analgesia in Group A (plain Bupivacaine and Lignocaine) was 7.84 minutes whereas in Bupivacaine and Lignocaine with Dexmedetomidine was 11.23 minutes. The duration time of effective Analgesia with plain Bupivacaine and Lignocaine was 9.65 minutes whereas in Bupivacaine and Lignocaine with Dexmedetomidine group was 13.84 minutes. It indicates that duration of complete and effective Analgesia in Group B was prolonged than in Group A.

Hemodynamic Parameters

Esmaoglu et al [15] had observed bradycardia in their patient group in which 100 μg of Dexmedetomidine was used with Levobupivacaine.

In our study, our observations showed that the hemodynamic parameters like Heart Rate and Blood Pressure and SpO_2 were in the optimal range in both the groups . The respiratory parameters were almost similar in both the study groups. Bradycardia and hypotension (transient) were observed in 3 patients in the Dexmedetomidine group.

The incidence of bradycardia was lesser in our study (only 3 cases) probably because of the lower dose of Dexmedetomidine we used. In our study we used 0.75 μg /kg of Dexmedetomidine with a maximum of 50 μg

Complications

All patients were monitored for complications during the intra-operative period and up to 48 hours post-operatively. The observations and particulars of each patient were recorded in the proforma enclosed. No complications or significant adverse effects were observed in both the study groups.[41]

CONCLUSION

Based on our observations, we conclude that in ultrasound guided supraclavicular block for elbow, forearm and hand surgeries, when compared to group A, the mixture of Bupivacaine, Lignocaine with Dexmedetomidine produces :-

I. Statistically significant faster onset of sensory and motor blockade.

2. Statistically significant increase in duration of sensory and motor block.

3. The hemodynamic parameters were within optimal range in both groups.

4. Statistically, duration of post-operative analgesia is significantly prolonged in Dexmedetomidine group.

5. No side effects were reported in our study group.

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LIST OF ABBREVIATIONS

ASA - American Society of Anaesthesiologists

NIBP - Non Invasive Blood Pressure

ECG - Electrocardiogram

SBP - Systolic blood pressure

DBP - Diastolic blood pressure

HR - Heart rate

SpO2- Oxygen saturation

VAS - Visual Analog Scale

PROFORMA

A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE- LIGNOCAINE AND BUPIVACAINE- LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY

Name:

Age:

Sex:

IP No:

ASA Status: Height: Weight:

Diagnosis:

Surgery:

Date of Surgery:

Anesthesiologist:

PRE-OP EVALUATION

GENERAL EXAMINATION

History:

Pallor: Icterus: Cyanosis:

Clubbing: Edema: Lymphadenopathy:

PR: BP: RR:

SYSTEMIC EXAMINATION

CVS: CNS:

RS: P/A:

INVESTIGATIONS

Blood HB%:

FBS/RBS: Urea: Creatinine:

Chest X-Ray: ECG:

PREMEDICATION

ANAESTHETIC TECHNIQUE

USG Guided: supraclavicular brachial plexus block

Group I: Patients receiving 15ml of 0.5% Bupivacaine + 15ml of 1% Lignocaine

Group II: Patients receiving 15ml of 0.5% Bupivacaine + 15ml of 1% Lignocaine + Dexmedetomidine 0.75 μg/kg

MONITORING OF VITALS

Intra-op:

TIME	PRE-OP	1 MNT	3	5	10	15	20	25	30	45	60	120	150
HR													
BP													
RR													
SPO2													

SUPPLIMENTATION

OBSERVATIONS: Time of injection of drug in to the supraclavicular brachial plexus:

SENSORY BLOCKADE:

Time of onset (The time interval between administrations of local anesthetic solution to loss of pin prick sensation)

Duration of sensory block:

Duration of complete analgesia (Time of starting of regression / Return of pinprick sensation / VAS is >0)

Duration of effective analgesia (Time for full Sensory Recovery / VAS is >4):

Time to first pain medication (VAS>5):

MOTOR BLOCKADE:

Motor Blockade (Time of onset):

Motor Blockade (Degree/ Modified Bromage scale for upper extremities on a 3-point scale): Grade 1 /2 / 3

Grade 0: Normal motor function with full flexion and extension of elbow, wrist and fingers

Grade 1: Decreased motor strength with ability to move the fingers only

Grade 2: Complete motor block with inability to move the fingers

Motor Blockade (Duration of block):

Time for full motor recovery:

Complications

Bradycardia, hypotension, dizziness, nausea, vomiting, dryness of mouth, inadvertent vascular puncture etc.

INFORMED CONSENT FORM

I am **Dr. Santhanababu V**, carrying out a study on the topic, "**A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE- LIGNOCAINE AND BUPIVACAINE- LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY"**

My research project guide is **Prof. Dr. Santhaarulmozhi D.A.,M.D.,** Head Of the Department and co guide **Dr. Radha M.D.,** Assistant prof. My research project is being carried out under the department of Anaesthesiology, Coimbatore Medical College and Government hospital.

RESEARCH BEING DONE:

"**A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE- LIGNOCAINE AND BUPIVACAINE- LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY"**

PURPOSE OF RESEARCH

- To compare the effects of Bupivacaine- Lignocaine and Bupivacaine-Lignocaine with Dexmedetomidine combination in ultrasound guided Supraclavicular brachial plexus block. The effects will be studied in terms of

- Hemodynamic responses
- Onset of sensory blockade and motor blockade
- Duration of sensory and motor blockade
- To compare post-operative pain levels
- Complications / side effects if any

SAMPLE SIZE:

60 patients.

STUDY PARTICIPANTS:

Adults aged 18-60years with ASA physical status I and II scheduled for elective open upper limb procedure.

LOCATION:

CMCH, Coimbatore.

PROCEDURES INVOLVED:

The research includes detailed clinical examination including medical history, physical examination. After the initial examination, patients will be randomly allocated into either two groups.

You, Shri./ Smt./ Kum. _____, aged ____ years, S/o / D/o / W/o _____, residing at _____ _____ are requested to be a participant in the research study titled **A COMPARATIVE STUDY OF ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE- LIGNOCAINE AND BUPIVACAINE- LIGNOCAINE WITH DEXMEDETOMIDINE IN ASA I &II PATIENTS UNDERGOING FOREARM AND HAND SURGERY"** in Government Medical College Hospital, Coimbatore. You satisfy eligibility criteria as per the inclusion criteria. You can ask any question or seek any clarifications on the study that you may have before agreeing to participate.

DECLINE FROM PARTICIPATION

You are hereby made aware that participation in this study is purely voluntary and honorary and that you have the option and the right to decline from participation in the study.

PRIVACY AND CONFIDENTIALITY

You are hereby assured about your privacy. Privacy of subject will be respected and any information about you or provided by you during the study will be kept strictly confidential.

AUTHORIZATION TO PUBLISH RESULTS

Results of the study may be published for scientific purposes and/or presented to scientific groups, however you will not be identified; neither will your privacy be breached.

STATEMENT OF CONSENT

I, _____, do hereby volunteer and consent to participate in this study being conducted by Dr. Santhanababu V. I have read and understood the consent form / or it has been read and explained to me in my own language. The study has been fully explained to me, and I may ask questions at any time.

Signature / Left Thumb Impression of the Volunteer Date:

Signature and Name of witness Date:

ஒப்புதல் படிவம்

பெயர் .

வயது .

பாலினம் .

முகவரி .

அரசு கோவை மருத்துவக் கல்லூரியில் நோய் குறியியல் மருத்தவ துறையில் பட்ட மேற்படிப்பு பயிலும் மாணவர் **மரு. வே. சந்தானபாபு** அவர்கள் மேற்கொள்ளும் **"அல்ட்ராசவுண்ட் வழிகாட்டுகல் மூலம் கைக்கு செல்லும் நரம்புப் பின்னலில் ஊசி மூலம் செயலிழக்கச் செய்ய பியூபிவியிகெயின் லிக்னோகெயின் மற்றும் பியூபிவியிகெயின் லிக்னோகெயின் டெக்ஸ்மெடிடோமிடின் மருந்தினை ஒப்பிடுதல்"** பற்றிய ஆய்வைப் பற்றி அனைத்து விளக்கங்களையும் கேட்டுக் கொண்டு எனது சந்தேகங்களை தெளிவுப்படுத்திக் கொண்டேன் என்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடனும், சுய சிந்தனையுடனும் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த அய்வில் என்னை பற்றிய அனைத்து விவரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதை தெரிவித்துக் கொள்கிறேன். எந்த நேரத்திலும் இந்த ஆய்வில் இருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

இடம்

தேதி நோயாளியின் கையொப்பம் / ரேகை

MASTER CHART

S.No	Name	Age	Sex	Group	IP No	ASA Status	Ht	Wt	Pre Op (HR)	1 mnt (HR)	3rd mnt (HR)	5th mnt (HR)	10th mnt (HR)	15 (HR)	20 (HR)	25 (HR)	30 (HR)	45 (HR)	60 (HR)	120 (HR)	150 (HR)
1	Thambiraj	55	Male	Group B	53627	1	1.6	70	118	112	95	95	72	70	66	54	48	49	55	56	55
2	Thangavelu	50	Male	Group B	582423	1	1.67	70	76	74	72	68	68	70	72	74	72	74	72	74	72
3	Manthra	27	Female	Group B	58631	2	1.65	75	90	88	80	76	72	74	70	72	74	76	72	73	76
4	Karupasamy	50	Male	Group B	58532	2	1.55	90	88	76	78	74	70	68	67	68	69	65	62	74	69
5	Vasanthi	48	Female	Group B	56594	1	1.5	65	96	88	74	72	73	72	72	74	70	72	69	66	74
6	Chinadurai	26	Male	Group B	58606	1	1.56	80	84	82	76	74	73	72	72	69	73	66	68	78	74
7	Manikandan	40	Male	Group B	62623	1	1.74	70	88	79	72	74	70	73	72	76	73	68	69	70	74
8	Poongodi	28	Male	Group B	61883	1	1.54	60	82	78	77	78	76	72	72	74	86	77	73	72	70
9	Nagaraj	28	Male	Group B	61883	1	1.63	70	96	88	74	72	72	76	76	75	72	72	69	72	72
10	Gouthami	30	Female	Group B	64074	1	1.67	60	86	84	78	78	84	77	76	72	69	72	73	78	82
11	Ponnusamy	32	Male	Group B	64031	2	1.65	78	66	89	78	72	70	68	68	66	64	57	56	62	62
12	Boopathy	22	Male	Group B	65631	1	1.7	60	102	96	84	78	72	72	76	78	68	66	70	72	68
13	Karthick	19	Male	Group B	64756	1	1.5	40	148	136	124	118	84	78	82	78	66	63	58	64	72
14	Sivakumar	25	Male	Group B	63841	1	1.67	70	68	68	66	61	58	57	57	55	57	58	62	59	62
15	Kumaravel	39	Male	Group B	67424	1	1.65	75	68	86	74	68	66	59	54	54	56	52	58	60	62
16	Karthick	24	Male	Group B	17917	1	1.6	55	92	92	90	84	78	76	75	72	68	66	67	68	72
17	Kumaresam	30	Male	Group B	68826	2	1.7	70	68	68	72	66	68	64	66	64	62	58	62	63	63
18	Joseph	30	Male	Group B	70075	2	1.58	60	88	83	86	94	102	81	72	68	70	74	72	74	72
19	Suresh	26	Male	Group B	71786	1	1.65	74	62	63	62	66	62	64	59	54	60	62	66	64	62
20	Chandrasekar	26	Male	Group B	71780	2	1.55	70	79	78	74	69	66	66	68	65	65	68	65	65	69
21	Barathi	18	Female	Group B	73596	1	1.6	55	100	98	98	87	88	73	68	68	66	62	58	63	68
22	Suresh	34	Male	Group B	73542	1	1.75	80	88	86	82	78	77	77	77	75	74	75	76	74	72
23	Kalaiarasan	27	Male	Group B	76534	1	1.76	60	78	78	77	78	75	76	77	74	74	78	84	86	78
24	Bhuvaneshwari	33	Female	Group B	73036	2	1.6	70	98	93	94	86	85	82	80	78	77	74	73	72	72
25	Santhosh	16	Male	Group B	72486	2-DM	1.55	70	78	78	77	75	76	75	74	77	73	72	68	70	72
26	Vijaya	33	Female	Group B	72740	1	1.68	75	96	92	88	86	87	84	82	83	82	83	81	80	76
27	Kabir	46	Male	Group B	79088	1	1.73	55	94	86	77	78	74	68	72	70	68	66	70	64	68
28	Balan	60	Male	Group B	71254	1	1.68	70	82	82	80	78	77	81	73	74	76	74	77	78	76
29	Nirmala	33	Female	Group B	73244	1	1.76	75	78	77	72	66	65	62	58	57	58	62	62	66	68
30	Ramesh	36	Male	Group A	78028	1	1.7	62	58	58	57	60	58	59	60	62	66	58	56	60	62
31	Sivallingam	40	Male	Group A	75844	1	1.65	53	92	91	88	86	82	78	76	76	74	73	73	68	72
32	Vellingiri	48	Male	Group A	70798	2	1.78	64	78	78	77	76	68	62	64	66	68	74	72	73	75
33	Usha	35	Female	Group A	74574	1	1.74	75	78	76	72	78	80	72	68	66	68	70	72	77	72
34	Inbaraj	20	Male	Group A	77576	2	1.6	50	92	85	78	76	76	75	74	74	73	72	68	70	72
35	Aabdul	32	Male	Group A	79690	1	1.75	80	68	67	68	62	58	57	58	58	62	68	70	76	72
36	Gopinath	32	Male	Group A	71060	2	1.55	70	78	77	78	81	73	71	68	66	69	72	72	73	74
37	Arun	16	Male	Group A	77810	1	1.5	60	76	76	74	73	76	72	72	74	69	70	68	76	82
38	Papusamy	60	Male	Group A	79954	1	1.75	70	82	80	76	78	74	71	62	66	58	63	59	65	67
39	Balamurugan	46	Male	Group A	76706	1	1.7	80	78	76	76	75	72	72	72	73	76	74	78	72	76
40	Chandrasekar	55	Male	Group A	73582	1	1.68	60	90	88	86	85	78	74	72	73	76	74	73	72	72
41	Ramraj	52	Male	Group A	78428	1	1.76	55	88	82	78	78	76	72	70	72	74	77	73	72	72
42	Amrose	17	Male	Group A	85939	1	1.6	45	108	92	86	75	76	68	72	69	68	68	64	68	68
43	Narayanan	45	Male	Group A	83490	2	1.8	85	72	70	68	66	65	68	68	70	72	68	66	70	72
44	Afsala	14	Male	Group A	86235	2	1.58	70	102	98	92	86	77	74	73	72	72	68	67	68	76
45	Dinesh	14	Male	Group A	83720	1	1.75	70	82	81	77	72	66	63	68	66	62	66	68	72	74
46	Stanley	40	Male	Group A	83602	1	1.74	85	66	66	73	72	72	76	75	77	72	70	72	74	76
47	Kandasamy	55	Male	Group A	77720	1	1.72	78	88	87	85	81	77	75	72	68	67	65	68	67	70
48	Palanisamy	33	Male	Group A	73306	1	1.7	65	86	86	85	82	81	78	76	75	72	77	72	73	74
49	Rathidevi	35	Female	Group A	74662	1	1.7	75	110	108	104	98	97	95	92	84	82	76	72	73	73
50	Antonyraj	35	Male	Group A	75876	2	1.72	78	68	68	67	66	67	65	64	68	65	63	62	62	64
51	Anamalai	42	Male	Group A	74922	1	1.72	68	78	78	77	78	76	75	76	74	72	73	74	72	73
52	Devi	50	Female	Group A	89230	1	1.68	55	90	88	89	87	82	78	76	74	72	72	73	74	72
53	Ranganayagi	55	Female	Group A	84100	1	1.76	62	82	82	80	76	78	78	76	77	78	72	74	72	73
54	Velmani	42	Male	Group A	82430	1	1.78	63	82	82	80	78	72	74	72	77	74	68	72	71	74
55	Nagammal	52	Female	Group A	81564	1	1.75	79	78	78	76	77	78	74	64	62	58	62	66	62	68
56	Janagiammal	50	Female	Group A	81513	1	1.68	55	83	83	82	78	75	76	72	73	76	78	73	76	74
57	Devi	50	Female	Group A	83536	2	1.65	80	68	68	62	58	53	48	48	50	46	42	44	56	64
58	Ramalingam	55	Male	Group A	77075	1	1.7	58	90	89	85	83	78	77	74	74	73	72	72	76	74
59	Gouthami	30	Female	Group A	81458	1	1.64	75	68	68	70	67	66	68	67	69	66	68	70	72	70
60	Ravindran	32	Male	Group A	81017	1	1.65	65	87	86	84	78	77	73	72	68	67	63	68	68	76

MASTER CHART

S.No	Pre Op (Systole)	Pre Op (Diastole)	1 min (Systole)	1 mint (Diastole)	3rd mint (Systole)	3rd mint (Diastole)	5th mint (Systole)	5th mint (Diastole)	10th mint (Systole)	10th mint (Diastole)	15 (Systole)	15 (Diastole)	20 (Systole)	20 (Diastole)	25 (Systole)	25 (Diastole)	30 (Systole)	30 (Diastole)	45 (Systole)	45 (Diastole)	60 (Systole)	60 (Diastole)	120 (Systole)	120 (Diastole)	150 (Systole)	150 (Diastole)
1	108	69	124	92	119	66	102	58	108	62	94	45	112	68	110	65	109	68	121	70	104	63	110	70	132	89
2	116	77	108	69	110	68	102	66	108	69	112	66	112	66	110	70	114	72	112	68	108	66	110	72	108	79
3	160	84	154	78	137	69	134	66	129	67	132	69	129	68	118	55	120	60	118	64	128	69	135	71	133	68
4	186	78	168	83	206	79	186	79	153	61	142	55	146	66	155	68	124	56	126	58	122	55	136	62	128	66
5	128	92	126	87	108	66	106	64	108	66	104	58	106	59	102	48	98	47	107	65	112	68	102	62	112	66
6	158	96	148	88	136	72	127	68	122	66	135	69	108	54	121	67	112	62	128	72	136	81	128	76	122	71
7	134	89	122	78	118	70	114	68	108	66	110	69	98	54	106	66	112	67	118	74	110	70	108	66	114	78
8	138	86	129	76	122	69	111	70	104	68	106	69	109	72	118	66	124	71	110	72	102	68	110	69	119	72
9	138	96	126	82	118	67	109	62	116	68	108	59	112	65	102	54	108	64	114	66	101	62	118	75	116	74
10	134	98	136	100	128	96	116	82	115	84	108	78	110	70	108	66	106	68	102	65	98	66	106	70	116	72
11	168	97	176	102	158	96	144	82	146	83	142	81	138	64	136	63	127	62	128	66	122	64	126	68	127	73
12	130	90	128	86	118	82	110	76	106	75	102	74	92	58	102	66	98	65	104	67	112	72	114	78	121	76
13	138	100	126	88	120	86	118	79	110	68	102	59	106	58	110	66	104	55	101	54	93	62	106	68	112	70
14	132	89	128	82	127	82	121	79	116	77	115	77	114	78	107	73	108	77	103	75	110	81	112	82	124	79
15	132	88	128	86	118	78	106	66	105	66	97	58	102	58	106	60	112	66	134	69	127	73	128	74	117	66
16	138	77	137	75	133	74	129	72	124	69	122	68	118	66	113	67	109	58	101	56	117	63	121	68	128	73
17	136	98	128	84	126	83	122	82	122	82	116	78	108	76	112	81	110	74	106	72	112	76	125	86	122	83
18	138	86	129	84	118	78	110	70	103	69	104	71	122	82	113	76	108	72	98	67	104	77	104	78	118	82
19	140	90	146	108	138	96	124	87	123	88	121	82	108	67	100	61	116	87	102	63	92	58	102	66	126	72
20	184	92	144	74	139	72	143	77	148	78	142	78	152	78	157	78	160	82	146	76	128	69	127	68	131	70
21	140	90	138	88	134	86	122	78	121	78	108	69	114	72	107	70	105	68	97	58	109	67	114	68	121	66
22	138	88	129	84	128	84	126	87	127	88	119	83	119	84	109	78	108	79	102	71	98	68	106	74	110	75
23	120	80	118	82	117	81	114	78	106	71	101	66	121	82	123	82	118	79	117	82	116	78	114	77	117	75
24	160	100	148	96	146	95	140	88	138	82	126	80	125	82	118	80	109	76	110	77	117	79	123	81	124	83
25	130	90	128	88	127	88	122	86	124	85	127	87	122	88	116	82	108	78	102	76	110	79	117	82	136	83
26	170	100	168	99	166	98	166	98	163	88	158	84	147	78	144	76	138	69	128	66	118	67	127	71	132	72
27	108	76	98	69	84	56	102	66	97	63	105	66	114	72	122	78	118	73	116	69	117	75	118	79	109	66
28	130	80	128	80	126	77	122	76	118	72	117	73	106	58	102	55	116	62	112	59	118	63	119	65	110	66
29	134	86	128	83	117	78	116	77	109	68	102	64	98	59	108	62	112	66	118	68	132	75	131	73	128	74
30	108	66	108	65	104	62	102	58	108	64	115	71	110	68	97	54	108	62	105	63	106	65	107	68	110	72
31	129	87	129	87	123	82	118	79	121	78	117	78	112	76	110	75	108	77	107	78	110	76	112	69	108	66
32	108	72	102	72	94	65	98	67	102	68	91	59	95	63	97	65	104	68	110	72	112	73	116	78	118	82
33	124	86	112	78	102	66	98	62	104	68	110	72	118	76	122	75	116	72	118	74	126	81	127	82	118	77
34	108	66	110	68	114	73	107	76	113	82	114	78	112	73	108	66	106	64	110	68	102	66	116	73	124	82
35	140	90	138	87	125	78	122	76	104	67	87	58	101	64	108	69	114	66	126	72	125	73	107	68	102	66
36	150	100	146	98	145	98	140	92	140	92	134	86	133	87	129	94	129	76	128	76	121	72	118	68	119	72
37	110	70	108	68	102	61	93	54	89	48	94	52	102	58	105	62	110	72	107	68	103	69	104	73	121	76
38	124	82	123	82	120	81	118	78	106	63	101	58	98	54	106	60	113	68	110	66	109	66	117	71	120	76
39	138	92	122	78	121	77	128	82	126	80	118	78	116	77	114	75	113	77	114	75	116	78	113	78	120	83
40	130	90	128	89	122	84	120	86	114	78	106	76	102	72	110	78	110	79	108	76	110	78	122	84	120	81
41	110	70	109	68	106	66	103	62	94	58	114	66	110	70	106	67	108	72	109	74	114	74	120	78	126	83
42	150	97	136	82	129	82	128	81	126	80	106	68	98	67	86	58	97	69	100	70	102	71	112	76	116	77
43	150	100	148	96	144	92	142	88	138	84	126	78	125	77	121	73	118	74	116	69	104	58	106	60	108	66
44	148	93	148	93	144	87	132	78	128	73	109	64	92	58	98	66	102	67	118	73	119	73	125	78	128	80
45	121	77	118	76	109	72	101	71	87	59	96	68	103	69	110	70	116	73	127	75	118	76	119	77	121	76
46	138	89	137	86	133	84	128	83	122	78	123	78	119	76	120	76	114	73	113	76	110	72	118	74	124	77
47	130	70	128	66	122	65	108	67	98	54	102	58	108	62	112	66	114	68	121	72	120	72	127	78	129	74
48	110	70	110	68	108	67	106	66	108	69	110	72	108	76	112	78	114	77	116	78	118	79	117	76	118	75
49	128	86	126	85	122	82	116	78	108	77	106	76	102	68	98	64	107	68	110	69	118	72	120	73	122	78
50	154	98	148	93	148	94	144	89	138	83	129	76	128	77	126	75	117	71	118	74	121	81	124	83	128	86
51	126	77	122	76	121	76	118	74	108	75	102	72	97	66	91	58	108	63	112	68	110	70	112	67	116	68
52	110	70	108	71	104	68	100	66	96	54	98	52	102	58	108	60	112	73	110	72	114	75	116	72	122	78
53	116	68	115	68	114	70	115	72	108	69	112	72	108	66	110	69	104	58	100	56	111	65	110	67	112	68
54	108	72	106	73	102	72	90	59	92	60	100	66	103	75	106	77	102	72	104	73	105	72	116	83	118	86
55	118	76	121	72	116	68	114	66	110	62	104	58	93	48	92	42	96	52	101	55	110	63	123	66	128	64
56	128	92	129	93	122	86	114	77	108	68	103	63	98	59	112	63	104	66	110	68	104	56	100	58	108	66
57	146	87	145	84	138	77	129	72	121	68	108	57	98	53	100	55	98	52	110	58	118	63	124	66	128	72
58	110	70	108	70	105	68	103	67	91	58	94	60	102	63	102	63	106	68	112	70	114	72	115	73	116	71
59	132	88	128	87	125	88	128	86	123	82	116	76	112	77	108	78	99	67	102	68	106	68	114	66	118	70
60	137	92	136	91	132	88	129	87	128	85	127	83	121	78	117	77	114	75	118	76	109	68	102	62	116	71

MASTER CHART

S.No	Pre Op(RR)	1 mnt (RR)	3rd mnt (RR)	5th mnt (RR)	10th mnt (RR)	15 (RR)	20 (RR)	25 (RR)	30 (RR)	45 (RR)	60 (RR)	120 (RR)	3rd mnt (SPO2)	5th mnt (SPO2)	10th mnt (SPO2)	15 (SPO2)	20 (SPO2)	25 (SPO2)	30 (SPO2)	45 (SPO2)	60 (SPO2)	120 (SPO2)	150(SPO2)
1	14	12	12	12	12	12	12	12	12	12	12	12	99	100	100	100	100	100	100	100	100	100	100
2	15	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
3	16	14	12	12	12	12	12	12	12	12	12	12	99	100	100	100	100	100	100	100	100	100	100
4	12	12	12	12	12	12	12	12	12	12	12	12	98	99	100	100	100	100	100	100	100	100	100
5	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
6	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
7	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
8	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
9	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
10	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
11	14	14	12	12	12	12	12	12	12	12	12	12	99	100	100	100	100	100	100	100	100	100	100
12	16	14	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
13	20	18	16	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
14	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
15	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
16	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
17	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
18	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
19	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
20	16	14	12	12	12	12	12	12	12	12	12	12	99	100	100	100	100	100	100	100	100	100	100
21	16	16	14	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
22	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
23	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
24	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
25	16	16	14	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
26	16	16	14	14	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
27	16	14	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
28	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
29	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
30	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
31	16	16	16	14	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
32	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
33	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
34	16	14	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
35	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
36	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
37	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
38	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
39	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
40	14	14	14	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
41	16	16	16	14	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
42	18	16	15	14	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
43	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
44	16	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
45	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
46	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
47	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
48	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
49	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
50	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
51	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
52	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
53	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
54	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
55	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
56	16	14	14	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
57	14	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
58	14	14	14	13	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
59	12	12	12	12	12	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100
60	16	16	16	14	14	12	12	12	12	12	12	12	100	100	100	100	100	100	100	100	100	100	100

MASTER CHART

S.No	Time of injection of drug	Time of onset	Duration of sensory block { Return of pinprick sensation}:	Time of onset Motor Blockade	(Duration of block) Motor Blockade	Time for full Sensory Recovery { mnts }:	Time for full motor recovery (mnts)	Duration of complete analgesia { VAS is >0 }	Duration of effective analgesia { VAS is >4 }	{ VAS >5 } Time to first pain medication
1	9.30 am	9.34am	12.1	9.37am	9.02	15.55	10	12.1	16.05	16.15
2	09.00 am	09.04 am	13.26	9.08am	9.1	14.26	10.3	13.26	14.46	14.56
3	11.15 am	11.20am	11.08	11.22am	9.53	14.15	10.15	11.08	14.35	14.55
4	09.10 am	9.15am	11.3	9.20am	10.02	13.15	11	11.3	13.35	13.55
5	11.10 am	11.15	12.03	11.20am	10	14.1	11.2	12.03	14.3	14.34
6	08.50 am	08.54am	11.56	8.58am	9.05	14.56	10.4	11.56	15.06	15.26
7	11.00 am	11.05am	12.52	11.09am	10.2	13.3	11.3	12.52	13.36	13.56
8	09.30 am	9.35am	11.32	9.40am	9.53	14.32	11	11.32	14.52	15.12
9	10.50 am	10.53 am	11.37	10.57am	10.02	13.15	11.3	11.37	13.35	13.55
10	09.00 am	9.05am	12.03	9.08am	10.23	14.07	11.3	12.03	14.27	14.47
11	09.15 am	9.18am	11.22	9.22am	9.55	14.05	11.4	11.22	14.45	14.55
12	10.40 am	10.44 am	11.49	10.49am	10.03	15.03	11.5	11.49	15.33	15.53
13	09.00 am	09.04 am	11.54	9.08am	10	15.3	11.4	11.54	15.5	15.25
14	11.00 am	11.04 am	11.26	11.09am	9.55	15.3	10.3	11.26	15.23	15.43
15	12.15 pm	12.18 pm	11.12	12.20pm	10.24	14.3	11.3	11.12	14.53	15.03
16	10.30 am	10.33 am	12.17	10.38 am	10.11	15.3	12.03	12.17	15.33	15.53
17	12.15 pm	12.19 pm	11.26	12.25 pm	9.55	13.5	10.15	11.26	13.35	13.55
18	09.10 am	9.15am	11.02	9.18am	10.11	13.15	11.55	11.02	13.25	13.35
19	11.00 am	11.06am	11.37	11.10am	9.55	14.15	10.3	11.37	14.35	14.44
20	11.20 am	11.25 am	11.35	11.30am	9.4	15.35	10.2	11.35	15.55	16.5
21	10.30 am	10.33 am	12.3	10.39am	10.21	15.4	11.3	12.3	15.34	15.48
22	11.50 am	11.55am	11.28	12.01pm	10.13	13.5	11.03	11.28	13.25	13.45
23	09.00 am	09.05 am	12.1	09.10 am	10.3	13.2	11.3	12.1	13.32	13.42
24	05.30 pm	5.35pm	11.52	5.39am	9.45	14.2	11.56	11.52	14.22	14.42
25	9.30am	9.35am	11.02	9.39am	10.16	13.5	12.2	11.02	13.35	13.55
26	09.00 am	9.06am	11.58	9.12am	10.29	13.5	12.28	11.58	13.45	13.55
27	08.50 am	08.53 am	12.03	08.58 pm	10.18	15.1	11.2	12.03	15.21	15.41
28	12.30 pm	12.35pm	11.38	12.40 pm	10.23	13.5	11.15	11.38	13.25	13.45
29	10.40 am	10.49am	8.29	10.53 am	7.15	10.45	9.12	8.29	11.15	11.35
30	10.30 am	10.37am	8.23	10.43 am	7.3	9.5	8.55	8.23	9.25	9.45
31	11.40 am	11.47 am	8.02	11.52 am	7.23	9.4	9. 15	8.02	9.24	9.44
32	10.30 am	10.40am	7.07	10.45am	6.4	9.15	8	7.07	9.35	9.55
33	11.30 am	11.41am	8.16	11.44 am	7.1	10.16	8	8.16	10.36	10.46
34	12.15 pm	12.24 pm	8.06	12.28pm	7.3	9.15	8.15	8.06	9.35	9.55
35	08.50 am	9.02am	7.36	9.10am	6.5	9.4	8.1	7.36	9.44	10.4
36	11.20 am	11.28 am	7.37	11.40 am	6.55	9.15	8.56	7.37	9.35	9.55
37	12.15 pm	12.24 pm	8.06	12.32 am	7.15	10.3	8.4	8.06	10.33	10.43
38	10.40 am	10.52am	8.02	10.58 am	7.3	10.15	8.3	8.02	10.45	10.55
39	11.30 am	11.40am	7.23	11.45am	6.4	9.3	7.3	7.23	9.33	9.53
40	11.20 am	11.28 am	8.32	11.34am	7.1	9.2	8.4	8.32	9.32	9.42
41	12.30 pm	12.38 pm	8.02	12.45pm	7.4	9.45	8.56	8.02	10.25	10.45
42	10.15 am	10.22am	7.27	10.30 am	7	9.5	9.3	7.27	9.25	9.45
43	09.00 am	9.12am	8.48	09.10 am	7.35	10.5	9.15	8.48	10.35	10.55
44	08.50 am	9.02am	7.37	09.00 am	7	9.4	9.15	7.37	9.34	9.44
45	10.45 am	10.53am	8.41	10.56 am	7.45	10.5	9.4	8.41	10.25	10.45
46	11.10 am	11.18 am	8.12	11.20 am	7.1	10.3	8.15	8.12	10.23	10.43
47	12.30 pm	12.39pm	7.56	12.48am	6.3	9.5	7.4	7.56	9.34	9.44
48	02.50 pm	2.58am	8.33	3.02 pm	7.15	9.4	8.41	8.33	9.34	9.45
49	10.30 am	10.37 am	7.53	10.43 am	6.45	9.3	8.04	7.53	9.33	9.53
50	11.30 am	11.37 am	7.23	11.49 am	6.4	10	8.3	7.23	10.23	10.53
51	11.50 am	11.58am	8.03	12.00 am	7.4	9.4	8.4	8.03	9.34	9.44
52	08.50 am	9.02am	8.19	09.00 am	7.3	9.35	9.2	8.19	9.55	10.04
53	12.20 pm	12.29am	8.02	12.34pm	7.27	9.3	8.5	8.02	9.33	9.4
54	10.20 am	10.28am	7.46	10.34am	7.05	10.05	9.34	7.46	10.35	10.55
55	10.30 am	10.39am	8.07	11.45am	7.3	9.4	8.4	8.07	9.24	9.44
56	12.30 pm	12.38 pm	8	12.42 pm	7.15	9.15	9.2	8	9.35	9.45
57	08.50 am	9.00am	7.36	9.10am	7.04	9.5	8.5	7.36	9.45	9.56
58	08.50 am	9-02am	8.01	9.15am	7.34	9.2	9.23	8.01	9.32	9.52
59	10.40 am	11.01am	7.52	10.55am	7.03	8.4	8.45	7.52	8.34	8.44
60	10.30 am	10.39am	7.46	10.45am	7.15	10.4	8.15	7.46	10.24	10.44